WITH METALLURGICAL SECTION

The Chemical Age

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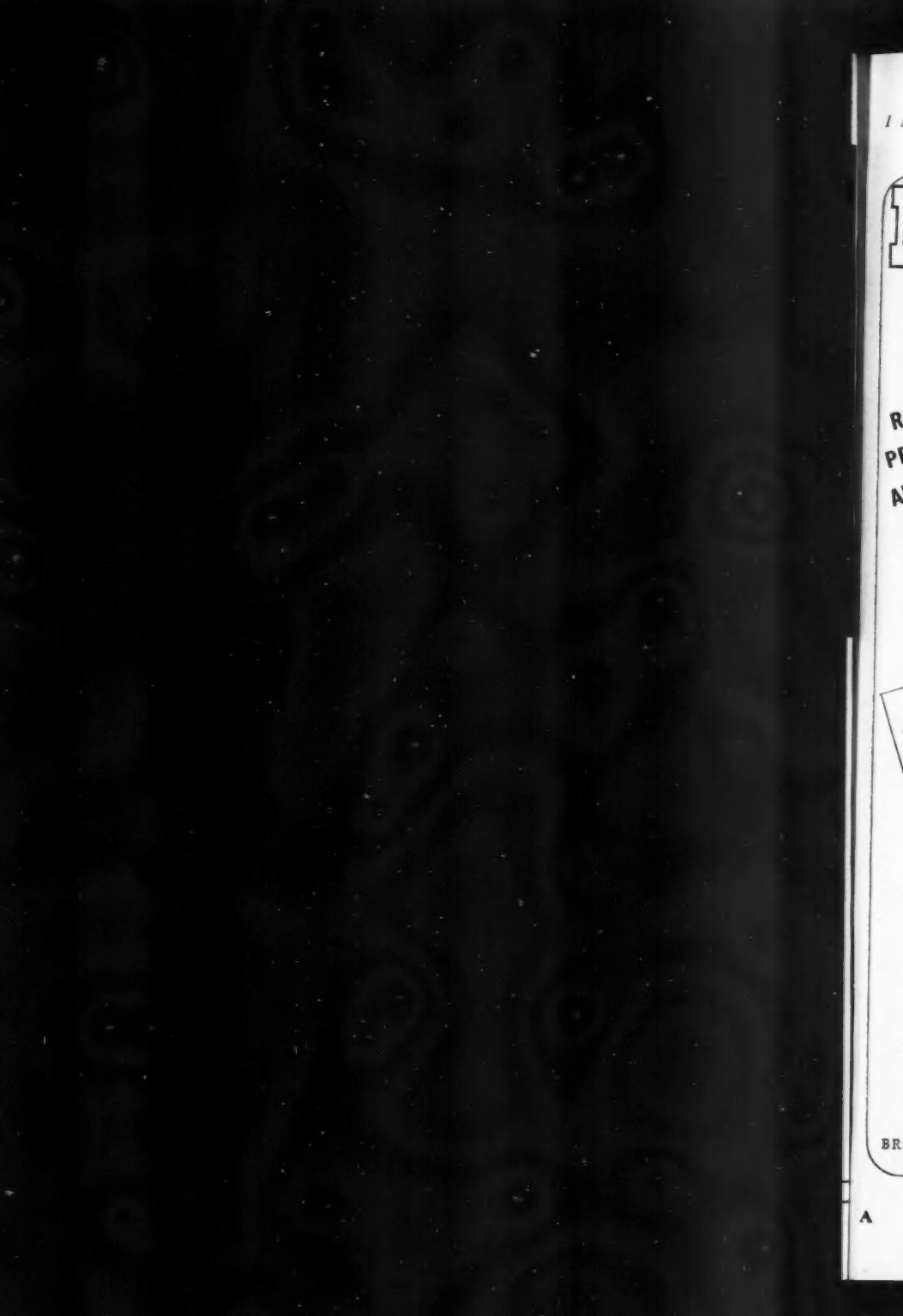

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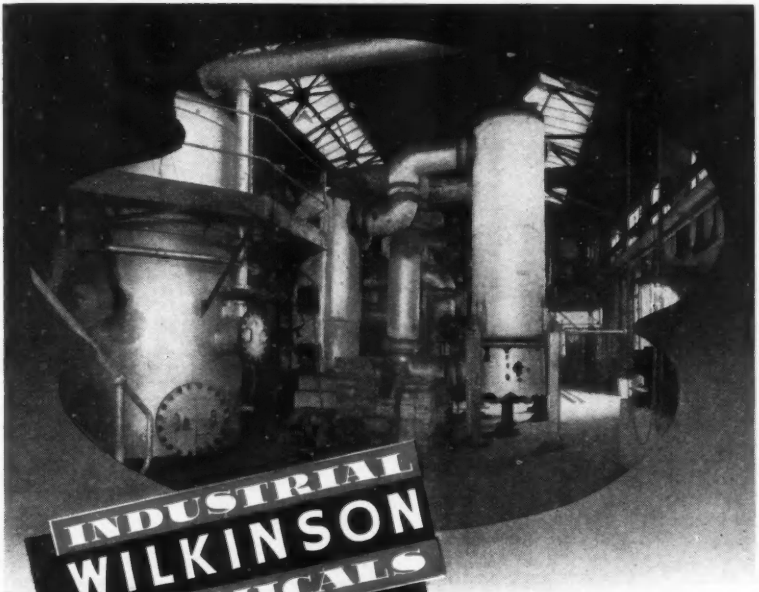

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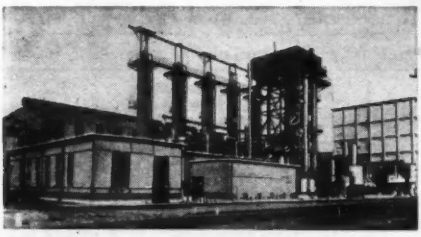

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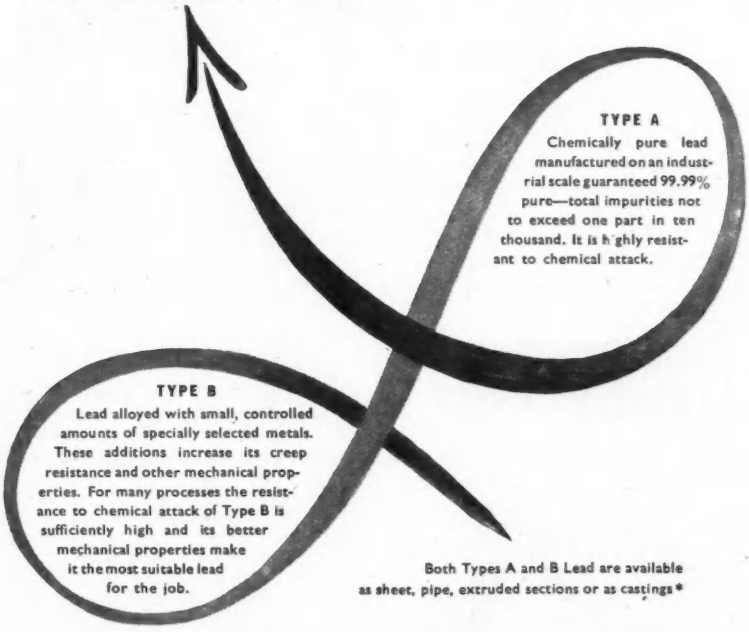

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Teddington Trends

ONCE again the annual report of the Chemical Research Laboratory is with us, this time, of course, for 1951 (HMSO, 126 pp., 4s. 6d. net). No less than last year it emphasises the changing shape of chemistry. A most inhumanly multilateral mind is required to assess with due appreciation these diverse contributions from Teddington; indeed, the specialist who can fully appreciate one of the six sections is all the less likely to be able to assimilate the others. The time has perhaps arrived when the Laboratory might consider making a twofold annual report, a main report in its present form supplemented by a shorter one—perhaps of some twenty pages—in which a simpler account of the year's principal activities is given. Admittedly there are dangers in over-simplification, especially when research that is far from complete is being reported, but readers themselves can make the necessary reservations that safeguard these risks. In the past the main problem in making scientific research results known was to describe them so that a reasonably intelligent layman could obtain a cross-sectional picture of current progress. It is still an unsolved problem, for there has always been a scarcity of scientific writers with the necessary aptitude. But today a second and perhaps more important problem is emerging—how to make sure that even the reasonably intelligent scientist can keep in broad touch with the sprawling and complex front lines. Or is the answer nakedly and coldly simple?—that the time has passed when it is possible, however desirable, for any working scientist to hope or try to keep in contact with all the moving boundaries.

When discussing the 1950 Report we expressed the hope that 'no general measures of national economy will be applied to the Chemical Research Laboratory . . . it is very clear that here expansion rather than contraction is nationally necessary'. It is satisfactory to learn that during 1951 some increase in the Laboratory's staff has taken place—164 have become 174; also, two new buildings, one for radiochemical research and one (prefabricated) for the microbiology section, are being respectively completed and erected. However, even the completion of these buildings will not solve the Laboratory's persistent problem of congestion. At numerous points in the 1951 Report, increases in the demands for the Laboratory's advisory services are mentioned. 'All Sections are

spending more time in dealing with enquiries.' This is obviously desirable but it inevitably calls for steady staff expansion or fundamental research studies must suffer. Yet accommodation must act as a limiting influence and even unique willingness on the part of the Treasury to sanction regular increases in staff costs will be pointless if there is little room to house more scientists.

No further information is given in the Report about plans for further building. With so much of the CRL research work directly related to changes that must take place in British industry and economics if this country is to avoid disaster —e.g. production of sulphur from sulphates by microbiological reduction, recovery of valuable metals from low grade materials, etc.—it seems imperative that no year should pass without actual expansion of facilities during it and without positive arrangements for further expansion. If it is comforting to note that nothing resembling an economy axe has fallen upon the establishment, it is disturbing to suspect that for the future the building programme is 'marking time.' Research that can make our industry more efficient, lessen our demands upon costly imports, reduce the wastage of metals by corrosion, etc., cannot mark time. In all our economic crises since the war it has been time that above all refused to stand still.

Both the Chemistry Research Board and the Director of the Laboratory express satisfaction with the response to the Open Days innovation, now in its fifth year. In 1951 919 visitors attended the Open Days held from 19-21 September. This method of increasing the Laboratory's two-way contacts with industry, government services, and other research workers, is certainly invaluable, but there are signs that this development has become static rather than dynamic. In 1949 there were 990 visitors on the Open Days and in 1950 918. No doubt space and staff limitations impose a ceiling upon the Laboratory's hospitality but even at the inevitable risk of interfering with research work we suggest that *two* short series of Open Days per year might now be considered. One measure of the Laboratory's immediate contribution to national progress is the volume of industrial inquiries it receives. The Open Day system has increased the inquiries by making the services of the Laboratory more widely known. When so much of our industrial efficiency may be improved merely by applying established scientific knowledge, the CRL would surely be well justified in taking risks of slight damage to their research effort and letting the Open Days and the consequent enquiries swell. In the end, indeed, the Laboratory's research capacity would no doubt be enlarged more speedily for no government could long deny the funds and materials of full expansion when so much demand was made upon the Laboratory's services.

On Other Pages

The annual subscription to THE CHEMICAL AGE is 35s. Single copies, 9d.; post paid, 1s.; SCOTTISH OFFICE, 116 Hope Street, Glasgow (Central 3954/5). MIDLANDS OFFICE: Daimler House, Paradise Street, Birmingham (Midland 0784-5). THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers Limited.

Notes & Comments

A Rare but Active Gas

THE commemoration of Sir William Ramsay's centenary must have made most chemists take stock of their knowledge about the atmosphere's rare gases. However, it has been left to a meteorologist to remind us that one of the rarest gases in the atmosphere is far from inert, but that we still know very little about its behaviour in the air. Dr. G. M. B. Dobson's article on 'Ozone in the Earth's Atmosphere' in the current issue of *Endeavour* (1952, **11**, 44, 215) should be widely read for it is packed with exceedingly interesting information on a chemical subject with which few chemists will be at all familiar. For every 4,000,000 molecules of other gases in the air, there is one molecule of ozone. But this small proportion of ozone is mainly located at a high altitude, above 10 and principally above 20 kilometres. It is believed to exercise important meteorological functions. It is a powerful absorber of both ultra-violet and infra-red radiation. This high 'belt' of ozone in the atmosphere removes most of the solar ultra-violet radiation in the 2200-3200A wavelength band and similarly it absorbs outgoing infra-red radiation from the earth. As a result this belt in the upper atmosphere has a relatively high temperature, which may be influential in the heat equilibria of air levels nearer the earth.

Amounts Variable

THE amount of ozone in the air near the earth's surface is very small; outside the tropics there are large day-to-day variations. The amount of ozone in the atmosphere above a specific place is measured by wave-length absorption technique; from the losses in certain selected wave-lengths the amount of ozone the light must have travelled through can be calculated. But to measure the concentration of ozone in air at a particular level, a chemical method must be used—e.g., air can be drawn through a mixed solution of potassium iodide and 'thio', the ozone, of course, liberating iodine which then reacts with the sodium thiosulphate. To determine the concentration of ozone at the high levels of the atmosphere where it is less 'rare' the very expensive method of balloons or rockets must be adopted. Daily ozone measurements are soon to be made at 15 different stations in or near Western Europe. We are tempted to remark that seaside resort claims about ozone seem to have anticipated scientific recording by a good many years. However, Dr. Dobson points out that in air containing any smoke the life of ozone is very short so it may well be that air on the coast and blowing in from the sea does indeed contain more ozone than air in the inland towns and cities.

Phosphorus & Animal Feeding

ONE of the critical ingredients of animal diet is phosphorus. The assumption that farm stock can obtain daily requirements of this element from pasture and feeding-stuffs such as cereals or oilcake is seldom justified by facts. The growth, fertility, or milk productivity of cattle having to manage on a less than adequate phosphorus supply are all adversely affected. Phosphatic materials have long been used to supplement ordinary feeding-stuffs. Hitherto, however, the principal materials used have been bone meal, steamed bone flour, meat-and-bone meal, fish meal, etc., that is to say, phosphatic materials of organic origin. The use of mineral phosphate has been very limited, despite the comparative cheapness and abundance of rock phosphate. The main objection to mineral phosphate has always been the geochemically associated fluorine. Wartime tests with rock phosphate as a sheep-feeding supplement confirmed this trouble. The rock phosphate contained 3.85 per cent of fluorine and a ration that supplied only as little as 6 milligrams of fluorine per day caused growth depression, increasing brittleness of bones, and reduced the weight of the thyroid gland. This research led to the idea of using defluorinated rock phosphate as a feeding-stuff supplement. Experimental quantities

of this new material were tested and it was found that their phosphorus content was almost as assimilable as the best bone meal or flour.

American Production Methods

THE American chemical industry is today producing many thousands of tons of fluorine-free dicalcium phosphate for animal feeding. According to a recent survey by *Chemical Week* (1952, **71**, 14, 37), four companies are together producing some 120,000 tons a year. In addition, 15,000 tons are produced as a by-product from gelatin manufacture. These main product processes are all based on elementary phosphorus so the question of fluorine removal does not arise. But two new plants are being erected which will be based upon rock phosphate; their expected production capacity together exceeds 150,000 tons per year. The ordinary wet-process or superphosphate process will be applied. One method of de-fluoridisation to be used is based upon brine. Brine is added to the acid phosphate liquor and on cooling sodium silicofluoride precipitates. This removes much of the fluorine present. The addition of lime to precipitate dicalcium phosphate is carried out in two stages. In the first about one-fifth of the dicalcium phosphate precipitates and this fraction contains most of the residual fluorine. This material is suitable only for use as a fertiliser. In the second liming operation the rest of the dicalcium phosphate is produced with less than 0.1 per cent fluorine content, which is satisfactorily low for feeding-stuff purposes.

Latin-American Prospects

THE chemical industry is at the moment feeling the effects of the general trade recession which makes it all the more important to take full advantage of every opportunity of development and expansion. A timely reminder of the rich potential markets in Latin America for British exports has been issued by the Credit Insurance Association Ltd., London. Unfortunately, as this survey shows, chances do not seem to have been taken and Britain is losing ground in the face of fierce competition from the U.S.A. and Germany. Latin America furnishes a third of the world market for U.S. exports (exclusive of MSA shipments) taking 40 per cent of her chemicals and medicines. Since the war German recovery has been remarkable. A rubber factory, a $2,000,000 coke plant, and a nitrogen fertiliser plant are indicative of the intense German activity. German 'follow-up' work is meticulous, a continuing market being ensured by sending technicians with their machinery who help in the installation. Brazilian imports of chemicals, pharmaceuticals and similar products according to the survey rose (in thousand metric tons) from 490 in 1950 to 696 in 1951 while Argentine imports of chemicals increased from 320,000,000 pesos in 1950 to 857,000,000 pesos in 1951. It is true of course, that Britain's chances in the Latin-American market are not at all simple. The important requirements of the Empire clash, because both are in the process of development and need similar goods. This has a bearing not only on industry's capacity to expand sales in both markets simultaneously, but the question of providing the necessary capital for such developments. The survey hopes for drastic action with Government support of a long-term policy or else a decision to abandon this rich trading area.

Chile Stocks Nitrate

AN agreement was signed in October between Chile and Brazil, under which the former undertakes to maintain a minimum stock of 25,000 tons of sodium nitrate in Brazil, to be drawn upon by the Brazilian Government as required. The price will be that ruling in the international market at the time each withdrawal is made. In return Brazil agrees: (*a*) to acquire exclusively Chilean nitrate, in equality of conditions; (*b*) not to set up plant to manufacture synthetic nitrogenous fertilisers, including synthetic ammonia and nitric acid; and (*c*) not to grant privileges or customs favours to any person to assist them in setting up such plant. The obligations assumed under items (*b*) and (*c*) will cease automatically if any South American country starts manufacturing synthetic nitrogen, or building plant for the purpose, in its territory.

Colonial Research

Chemistry's Vital Rôle Shown in Council's Report

INCREASING difficulties arising from the uncertainty regarding the provision of further Colonial Development and Welfare Funds after the present Acts expire in March 1956, are noted with much concern by the Colonial Research Council. Not only is long-term research being rendered impossible, but recruitment of research workers for the Colonial territories is being hindered.

One point emphasised by the Council is the value of direct contact between research organisations and institutions in Britain and the Colonial territories. The useful activities of the travelling Colonial liaison officers of some organisations is noted and the hope expressed that other such appointments will be made whenever justified.

These matters are discussed by the Council in its report contained in 'Colonial Research 1951-1952' (Cmd. 8665, H.M.S.O. 6s. 6d.), which also contains the reports of the nine specialist advisory research committees which are annexed to the Council.

Chemistry plays a vital rôle in many of these reports and a summary of some of the main chemical and technical investigations, completed or in progress, is given below.

Work of the Colonial Products Advisory Bureau has not hitherto been included in the Council's report. Formerly the Plant and Animal Products Department of the Imperial Institute, it was taken over by the Colonial Office in 1949.

Amalgamation Next Year

It has been found, however, that the work of the Bureau covers much the same ground as that of the Colonial Products Research Council. Where the latter body is mainly concerned with fundamental research, the former is mainly occupied with *ad hoc* investigations.

No clear line of demarcation would appear possible between the two sets of activities, and it is therefore proposed to bring the work of the two bodies under a common directorship at the beginning of next year.

During the year under review the Bureau completed 82 laboratory investigations and 801 inquiries were dealt with.

Work in connection with international methods for the evaluation of pyrethrum was continued, and research was also carried out on standard dilute solutions of pyrethrum for use in biological assays, and on the storage performance of the flowers in powder form.

A series of chemcal analyses and biological trials was commenced in co-operation with Rothamsted, on new strains of pyrethrum flowers which have been developed in Kenya. The investigation is of the utmost significance as it is necessary to correlate the increased pyrethrin content of these strains with their insecticidal activity.

Hard to Separate

Analysis of pyrethrum suffers from the difficulty of separating the several active principles which impart the insecticidal activity. The importance of applying chromatographic methods of separation has been recognised, and research in this connection has been carried out jointly with Rothamsted. Pyrethrins I and II have been separated on both alumina and silica columns.

On alumina columns there is some evidence of the separation of the cinerins from the pyrethrins. Material separated in this way has been used to elucidate separations obtained by chromatography of pyrethrum extracts on paper impregnated with alumina, and by paper chromatography of 2: 4 dinitrophenyl hydrazine derivatives of the pyrethrins.

In order to overcome the difficulty of obtaining wood pulp from hard currency countries, renewed attention was directed to the possibilities of utilising Colonial timbers and agricultural wastes. In past years, a considerable number of such materials had been investigated at the Bureau, and the principal one to find industrial application was *Eucalyptus saligna*.

Brachystegia wood from Tanganyika examined during the year was shown to possess a fairly satisfactory cellulose content; 51.4 to 58.8 per cent on moisture-free material, but the average length of the ultimate fibres, 1.0 to 1.2 mm., places it in the category of short-fibred materials for papermaking. To obtain a well-digested pulp by the soda process the conditions required

were somewhat severe, and the consumption of soda was rather high. All the pulps were weak in character, and yields were only moderate, 45 to 50 per cent of unbleached pulp.

Under standardised conditions of single-stage hypochlorite bleaching, the pulps required very severe treatment. The loss on bleaching was satisfactorily low, and the pulps suffered little deterioration. On the whole, the papers furnished were soft, bulky, and rather attractive in appearance.

A critical examination was carried out on the petioles of the *Nipa Palm*, with a view to utilising the large quantities available in Sarawak. It showed that the material exhibited undesirable features when pulped by either the soda or sulphite processes, the chief of these being the heavy consumption of chemicals together with low yield, dark colour and high drainage time of the pulps produced.

Cause of Wetness

Microscopical examination of the fractionated pulp showed that the wetness was due mainly to the presence of relatively large amounts of non-fibrous tissue, which would present serious difficulties in a paper mill. It is unlikely that the petioles would be an economic source of paper pulp, owing to the high costs of working, and the necessity for removing the parenchymatous tissue.

Sorghum stalks gave a satisfactory yield of easily bleached, moderately strong, short-fibred pulp. Fairly severe conditions of cook were required, and the chemical consumption was rather high. The strength of the pulps was not increased to a very high level by beating. The pulps would be suitable for incorporation with longer-fibred material in the manufacture of paper, and could be used alone or in admixture in the production of certain types of fibre board.

In the yield of vegetable fibres work had proceeded on two main lines: the examination of jute, jute substitutes and the commercially important fibres, and methods of fibre identification.

Most of the jutes examined were promising, and the main criticisms concerned the state of preparation and the strength. It was considered that proper attention to the control of the retting process, and the bundling of the fibre, would in most cases produce jute of commercial value.

The substitutes examined were all found to be somewhat lacking in strength, and characterised by an inherent coarseness that would not permit them to be spun down to the fine counts necessary to achieve satisfactory production-efficiency on modern jute machinery. Given good preparation, most of the substitute fibres would nevertheless be suitable for conversion to the coarser types of sacking.

Fibre identification represents an important aspect of the Bureau's work since fibre samples of unknown or dubious origin are submitted. The customary schemes of preliminary identification based upon burning, staining and other chemical tests are of very limited applicability, as all the stem and leaf fibres react very similarly. Microscopical examination is of much greater value, and a start has been made in building up a reference collection of photomicrographs of fibres obtained from botanically authenticated plants.

Other investigations included consideration of supplementary sources for tanning materials, suitability of samples of new tobacco leaf, examination of oilseeds from Northern Rhodesia, and of various foods and feeding stuffs.

A wide range of investigation is covered in the ninth annual report of the Colonial Products Research Council.

Molasses not Satisfactory

Improved methods for the preparation of lævulinic and lactic acids from sucrose were worked out in the Birmingham University Laboratories by the late Sir Norman Haworth and Professor Wiggins. The possibility of utilising these for their manufacture was being studied in Trinidad. The preparation of lævulinic acid from molasses had been examined, but certain difficulties had been encountered and the yield so far had been unsatisfactory. It was hoped to overcome these difficulties by further work.

Although most of the lactic acid now manufactured was made by fermentation processes a chemical method would have many advantages in tropical countries. Since for many industries the esters of lactic acid are required, the possibility of preparing these without isolation of the acid had been examined. These experiments were very promising and were now being further studied.

In view of the availability of considerable

quantities of bagasse which are not required for the production of power in the sugar mills, a detailed knowledge of its constituents was desirable if other uses were to be found for it. It is already known that the principal constituents are cellulose, pentosans and lignin. The possibility of separating these had been studied and a successful process, using an alkaline solution, had been found for isolating the cellulose in a form suitable for the manufacture of paper. In view of the world shortage of pulp the Council considers this work important.

Investigations on the most suitable method for the production of bacterial cellulose from sucrose and other carbon sources had now reached the stage when it seemed desirable that trials should be conducted in a pilot plant in order to determine whether cellulose prepared by this method could be produced at a cost enabling it to meet some of the normal industrial requirements.

The work in Professor S. Peat's laboratory during the past year had been concerned mainly with the confirmation of previous results obtained with starch metabolising enzymes. Improved methods had been devised for the isolation and purification of these enzymes and with these purer specimens a clearer definition of their functions was now possible.

Knowledge of Starch Essential

While this work was at present only of scientific interest and importance a full knowledge of all aspects of starch chemistry was essential if a technical use was ultimately to be made of the potentially rich sources of starch available in the Colonies.

In spite of the experimental difficulties due to the small quantity of material which can be isolated, progress was made in the study of the germination factor of Striga.

This work was being carried out in the Chemistry Department of the University of Cambridge by Dr. A. W. Johnson and by Dr. R. Brown of the Department of Botany, University of Leeds. The crystalline factor had not yet been obtained, but preliminary chemical work had been carried out on the resinous concentrates.

It was too early to speculate on the chemical nature of the compound. Segments of the host root had been shown to convert glucose to the active principle and it was possible that 2-ketogluconic acid, which had been isolated from the reaction product, was an intermediate.

Earlier investigations in the Birmingham Laboratory had confirmed that the primary alcohol groups in carbohydrates could be oxidised to carboxyl groups by treatment with oxygen in the presence of a platinum black catalyst. Mr. J. G. Fleetwood had attempted to prepare uronic acids containing amino and phosphate groups by this simple and effective method.

Unfortunately the method failed completely with glucosylamine and glucosamine and the facile oxidation of α-and β-methylglucosides was inhibited in the presence of ammonium salts or of glycine. On the other hand the Cori ester gave tripotassium α-D-glucuronate-1-phosphate. This salt was therefore available for the first time and experiments had already shown that it would prove of value in enzymic syntheses of polyglucuronides.

Useful Intermediates

Mr. G. P. McSweeney, as part of an extended study of acetals and ketals of the polyhydric alcohols had been investgating the *iso*propylidene derivatives of D-sorbitol and L-iditol. This work had resulted in the preparation of substances likely to lead to useful intermediates for the synthesis of hexitol derivatives.

Work on the preparation of trifluoroacetyl derivatives of the carbohydrates was being carried out by Mr. A. J. Huggard. Some further derivatives—4: 6-benzylidene trifluoroacetyl-α-methylglucoside—had been very thoroughly investigated, and a start made with the study of the condensation products of hexitols with trifluoroacetone. Mr. J. Roylance was examining the fluorination of heterocyclic substances derived from cane sugar.

Although it was known from the earlier experiments of the late Sir Norman Haworth and Professor L. F. Wiggins (British Patent No. 683,533, 1944) that sucrose could be converted into lævulinic acid in excellent yields (75-80 per cent) the method had not been applied to molasses. Preliminary experiments had now been carried out at the Sugar Technological Laboratory, Trinidad, with this material in a specially designed autoclave resistant to the attack of hydrochloric acid. So far yields of only 42-47 per cent of the acid had been obtained and Professor Wiggins admits that the project is one of con-

siderable difficulty. Since an industrial offer had been received for the purchase of a large quantity of the acid, it was desirable that further experimental work should be carried out.

Experiments were carried out by Mr. J. Drane in the Physical Chemistry Department, to find an accurate method for the determination of the aconitic acid content of molasses. This estimation was of importance since the recovery of the acid from molasses was only economic when not less than 2 per cent of acid was present. An attempt was made to use the polarographic method of analysis, but various difficulties were encountered. The majority of these were successfully overcome and it was anticipated that a satisfactory method would be devised.

In timber research Professor F. E. King and Mr. J. A. Baker had separated from *Mimusops heckelü* (West Africa), a saponin which contained sulphur and yielded on hydrolysis a crystalline hydroxy-triterpenoid acid, $C_{30}H_{46}O_5$, together with xylose, rhamnose, glucose, and a sulphate ion. The acid appeared to be saturated and it contained adjacent hydroxy groups, since it yielded an *iso*propylidene derivative.

Four Years' Trials

Results of four years' fertiliser trials both on native food crops by the East African Agriculture and Forestry Research Organisation and by the Kenya Department of Agriculture are referred to in the seventh annual report of the committee for Colonial Agricultural, Animal Health and Forestry Research. These results were being re-examined and prepared for discussion by a specialist committee on Fertiliser Responses, which would report on the work as a whole.

Work of the Colonial Insecticides, Fungicides, and Herbicides Committee is shown by its fifth annual report to have continued much as in previous years. At Porton two entomologists, a chemist and two junior assistants had continued basic studies connected essentially with factors influencing the toxity of residual insecticides applied to houses for malaria control and the production of semi-permanent insecticidal coatings. Closely connected studies were being made for the Committee at the Imperial College Field Station and at the Rothamsted Experimental Station.

Studies on the way in which contact poisons were picked up by insects, and the influence of particle size and the type of surface on the amount picked up, and on toxicity, had produced important results that would undoubtedly contribute considerably to improvements in insecticide formulations and methods of application.

In the report of the Tsetse Fly and Trypanosomiasis Committee it was shown that while '*Antrycide*' was a most useful curative drug of trypanosomiasis of cattle, it was far from being infallible for all stages of the disease. It was effective against the acute stages of *Trypanosoma congolense* and *T. vivax*. In the chronic stages of the disease a single injection was not fully effective against either trypanosome.

Continuation of protective doses of 'Antrycide' mixture at monthly and two-monthly intervals to groups of cattle exposed to constant attack by *Glossina austeni* proved to be disappointing. These frequent doses failed to produce a durable and sterile prophlaxis. Evidence of late appearance of trypanosomes in the blood, a picture of anaemia in the blood, tissue changes at autopsy and the demonstration of trypanosomes in the heart, lung, and kidney indicated that the protection given by 'Antrycide' was not absolute. The drug had evidently acted as a suppressant, not a prophylactic.

At a meeting of the International Committee for Trypanosomiasis Research, Dr. Lourie announced the discovery of a new chemotherapeutic agent for use against *T. congolense* infection in cattle. This substance, at present known as '528,' was a chemical type that had not hitherto been used in the chemotheraphy of trypanosomiasis. Tests in mice had shown that the chemotherapeutic index of '528' was almost the same as that of 'Antrycide.' Sufficient quantities of the drug were being prepared to enable field trials to be carried out.

Awarded Challenge Trophy

The Farmer & Stockbreeder Challenge Trophy for the best trade stand on the ground floor of the Grand and National Halls at the Dairy Show at Olympia, London, was awarded to British Glues & Chemicals, Ltd. The main feature of the stand was a pictorial panel illustrating the reason why minerals are needed. Six attractive coloured photographic units drew attention to the guaranteed phosphorus contents of Churn Mineral Feeds.

U.S. Ethylene Oxide Production

Direct Oxidation Coming into its Own

TWENTY years after the first discovery of the process, the production of petrochemical ethylene oxide by direct oxidation is finally coming into its own. Three plants using it are now under construction in the United States, and another in France. This is the first important constructional activity in this field since the late 'thirties, when the new process attracted two companies in the U.S.A. (Carbide & Carbon Chemicals Company, and U.S. Industrial Chemicals, Inc., which last has discontinued these operations), one in Germany (I.G. Farbenindustrie at Zweckel), and one in England (Distillers Co., Ltd.).

Now under construction is a $5,000,000 direct oxidation plant for the Solvay Process Division at Orange, Texas, another for the Jefferson Chemical Company at Port Neches, Texas, and a third, using some features of the process, is being built for Hancock Oil Co. at Long Beach, Cal. In addition, Carbide & Carbon Chemicals Co. has significantly expanded its direct oxidation facilities. In France, Société Naphthachimie is building an ethylene oxide plant of this type, and in Belgium, Société Carbochimique is using a process similar to that of Hancock Oil Co.

Chlorine Shortage the Cause

The reason for all this activity is to be found in the critical chlorine shortage, which affects the economics of the competitive chlorohydrination process for ethylene oxide production (which consumes over two tons of chlorine for every ton of ethylene oxide). At the same time, significant engineering developments in recent years have reduced both the yield and the high capital requirements which had previously detracted much from the appeal of the direct oxidation process.

The markets for petrochemical ethylene oxide seem insatiable. At the beginning of 1951, U.S. production was 243,750 tons. Since that time, new projects have been undertaken which are due to raise the total output to 428,500 tons by 1955 (i.e., a 78 per cent expansion in four years). The consumption pattern has been shifting during recent years from its heavy accent on ethylene glycol production to alternative outlets, notably in the field of monomers for synthetic fibres and plastics. In 1952, the following principal markets are reported for petrochemical ethylene oxide in the United States.

Ethylene glycol	219,000	tons
Acrylonitrile	22,300	,,
Ethanolamines	18,000	,,
Polyglycols and others	26,800	,,
Non-ionics	13,400	,,
Misc.	18,000	,,
Total	317,500	,,

Commercial production of ethylene oxide today follows two routes. Of these, the direct oxidation method, which is here under consideration, follows the equation:—

$$CH_2=CH_2+\tfrac{1}{2}O_2 \rightarrow CH_2-CH_2 \quad (O)$$

The reaction, originally based on the work of T. E. Lefort, is carried out over a silver-base catalyst in all known instances. Different types of carrier, principally in the alumina class, are being employed.

It is customary to mix ethylene with a large excess of air, enough to maintain the concentration below the explosive limit. The gas mixture is preheated in exchange with the product and is introduced into the catalytic converter in which the temperature is carefully controlled. The optimum value varies within the range 200-300°C., depending on the age and activity of the catalyst. Per-pass conversion is held at 40-45 per cent. In order to prevent excessive build-up of inerts in the converter gas, a portion of the reactor 'make' is bled from the system (after the removal and recovery of ethylene oxide). The remainder is recycled for conversion of residual ethylene. In this manner, an overall yield of 50 per cent of theory is obtained for a commercial catalyst operating at a conversion efficiency of 55 per cent.

In recent years, much activity has been directed toward the development of improved catalysts. Conversion efficiencies as high as 65 per cent of theory have been

reported. This means an overall yield in the range of 60 per cent.

An outstanding feature of the process is that there are, in effect, no by-products other than carbon dioxide and water. The only organic impurity is acetaldehyde. At reaction conditions, its formation can, however, be readily held at values as low as 0.02 per cent of the ethylene oxide formed.

Exothermic Heat Influenced

The conversion efficiency influences significantly the exothermic heat evolved in the reactor. Thus, the partial combustion of one gram-mole of ethylene to ethylene oxide is accompanied by the evolution of 56 k.cals., while the heat generated by the complete oxidation of the same quantity of ethylene amounts to 631 k.cals. If the reaction, therefore, is carried out with 50 per cent conversion efficiency, only 8.1 per cent of the total heat evolved is due to the formation of the desired product. It is therefore evident that yield is significantly related to investment cost per unit product, since adequate provision must be made to abstract the heat of reaction from the system.

Reactor design follows the lines taken for oxidation of naphthalene to phthalic acid and of fixed-bed catalytic cracker cases. The basis is a tubular reactor system. The catalyst is carried inside the tubes, while a heat-transfer medium (usually a hydrocarbon oil) is circulated through the shell and from there through external water-cooled heat exchangers.

The use of fluidised catalyst beds has been proposed for this reaction by the patent literature. Its application would follow the lines taken at Sherwin-Williams plant for the partial oxidation of naphthalene. Insofar as is known, however, this scheme is not now being used commercially for the manufacture of ethylene oxide.

The choice of corrosion-resistant materials is essential. The presence of rust inside the reactor tubes would catalyse the formation of formaldehyde and formic acid, and the complete combustion of ethylene.

The ethylene concentration in the mixed reactor feed must be held at a maximum of 3 per cent in order to prevent the existence of an explosive condition. In single-stage operation, this will result in a very low product concentration in the 'make' stream. The resulting recovery problems and ethylene oxide losses are very severe.

It is, however, possible to boost product concentration by operating several reactors in series. Enough make-up ethylene is admixed to the depleted reactor gases between stages to boost its content to the permissible limit at the entrance to the reactor unit. In this manner, ethylene oxide concentration in the 'make' may be obtained at levels as high as 7-8 per cent. The practical limit to the permissible number of stages is set by (a) increasing capital cost, (b) decreasing yield as the air/ethylene ratio is lowered below its optimum value above 7.

The purity of the feed ethylene plays an important rôle in the successful execution of the direct oxidation reaction. The presence of other hydrocarbons and of hydrogen contributes to the heat of reaction without doing any useful work. Acetylene must be carefully removed because of its deleterious effect on the catalyst and because of the real danger of forming explosive silver acetylides. Since all ethylene, produced by the thermal (or oxidative) cracking of hyrocarbons, contains small amounts (usually 2-3 per cent) of acetylene, a suitable purification stage must precede the ethylene oxide plant. Of outstanding suitability for the removal of acetylene are its preferential hydrogenation to ethylene (over palladium-silica gell or nickel-kieselguhr catalysts), or absorptive treatment with such solvents as acetone, acetonyl acetone, or dimethyl formamide.

High Concentration Possible

An ethylene content of 97-98 per cent can be achieved economically in the type of purification system employed most commonly—low-temperature fractionation. This concentration is therefore commonly employed in the direct oxidation process. Attempts have been made to operate with lower concentrations by suppressing the complete combustion reactions. One such process, in which an 'anticatalyst' (probably ethylene dichloride) is proposed, is claimed to be feasible in conjunction with ethylene feed concentrations as low as 10 per cent (i.e., a number of refinery gases would serve adequately with only little intermediate purification). Fifty to sixty per cent ethylene has been used at one commercial American ethylene oxide installation, though at a reduction in plant capacity.

Pressure does not have a favourable effect

on the reaction and normal reaction conditions are slightly above atmospheric pressure. Maintenance of closely controlled temperature conditions is, on the other hand, of extreme importance. Optimum operating level is influenced, above all, by the age and activity of the catalyst. In addition, ethylene and oxygen concentration and the gas velocity exert an important effect on the optimum temperature. A contact time in the range of 1.5-4 seconds is chosen for commercial operation. By increasing this residence time, at any given temperature, per-pass conversion (and with it, the overall yield) can be boosted. The limit to this procedure is, of course, set by economic limitations occasioned by the requirements for larger reactor equipment. Attempts to deviate from the optimum temperature result in increased carbon dioxide formation at higher levels, while a reduction in operating temperature will lower the conversion rate to ethylene oxide. Normal operating temperature is in the range of 200-300°C.

Inhibitor Introduced

Brief mention has been made above of the use of 'anticatalysts' for the suppression of complete combustion. This scheme embodies the introduction of small amounts of inhibitor into the feed-gas stream. The use of ethylene dichloride in this connection has been the subject of careful investigation. Here, too, a silver-base catalyst is employed. It is found that ethylene dichloride, in very small concentrations, does indeed have a very favourable effect on the efficiency of the partial oxidation of ethylene. The addition of excessive ethylene dichloride to the gas stream results in poisoning of the catalyst. Catalysts poisoned in this manner can be regenerated by continuing the reaction at a higher temperature level in the absence of ethylene dichloride. It is indicated, however, that a catalyst, once poisoned, suffers considerable loss in its normal life expectancy of about one year.

The common commercial method employed for the recovery of ethylene oxide from the reactor 'make' gases is absorption in sulphuric acid, or in water under pressure. In the former case, the product is immediately hydrolysed to ethylene glycol and is recovered as such. Where the recovery of ethylene oxide itself is desired absorption in water under pressure serves to good advantage.

In at least one commercial plant, ethylene oxide has been recovered by adsorption on activated charcoal. In order to avoid the formation of glycol, which is removed only with difficulty from the carbon, rigorous exclusion of alkali from the adsorption medium is necessary, and the amount of moisture must be maintained at a minimum (gases entering the reactor are normally saturated with moisture at the temperature of the surroundings. In addition, some water is formed in the reactors by the complete combustion of part of the hydrocarbon feed). The recovery scheme by adsorption is beset with difficulties due to a tendency of ethylene oxide to form polymerisation products on the surface of the activated charcoal. Desorption of recovered ethylene oxide can be effected by means of superheated steam.

Where formation of ethylene glycol is the ultimate objective, a 1 per cent sulphuric acid solution is used for absorption of ethylene oxide and simultaneous hydrolysis. Higher concentrations would promote the formation of higher glycols. The concentrated (20 per cent) glycol solution is neutralised and further concentrated in vacuum operation. It is finally purified by fractionation.

A recent innovation in the process (used by Hancock Oil Co.) substitutes oxalic acid for sulphuric in the hydrolysis to glycol. On the completion of hydrolysis, the residual oxalic acid is precipitated as calcium oxalate by reaction with milk of lime. Calcium oxalate can be removed by filtration, and destruction of oxalic acid can be made quantitative in this fashion. The claim is made that this procedure avoids difficulties in the distillation step which are sometimes encountered due to the presence of sulphate ion carried into this stage in the more conventional sulphuric acid hydrolysis method. Oxalic acid is reported to be only 24 lb. per ton of glycols, which are composed of 88 per cent ethylene glycol, 10 per cent diethylene glycol, and a small amount of higher polyhydric alcohols.

Scheelite in Brazil

A report from Joao Pessoa, Brazil, states that extensive reserves of scheelite have been found at Campina Grande, Paraiba do Norte.

Brazilian Alkali Company

Government to Make NaOM & Barilla

AMONG the projects approved by the Brazil-United States Commission for Economic Development, and now before the International Bank for Reconstruction and Development, awaiting decision, is one recommending a loan of U.S. $15,000,000 to the 'Companhia Nacional de Alcalis.' This sum will be employed to finance imports of equipment for the factory, now building at Cabo Frio, in the State of Rio de Janeiro, to manufacture caustic soda and barilla (*see* THE CHEMICAL AGE, 24 November, 1951). Loans granted by the International Bank are used to buy foreign exchange and pay for purchases in any country. Those authorised by the Export-Import Bank cover imports from the United States only.

The cost of buildings and installations at Cabo Frio, exclusive of the materials to be imported, is estimated at £4,000,000. The plant will have a capacity of 100,000 tons annually of carbonate of soda, which will yield 72,000 tons of barilla, 20,000 tons of caustic soda, 22,000 tons of plaster of Paris and 27,000 tons of calcium carbonate. These proportions may be revised later in accordance with market requirements. The factory is expected to begin operating at 60 per cent of capacity in 1955 and the gross yearly profits are estimated at £760,000.

With the exception of fuel oil for the boilers and furnaces, which must be imported until Brazil's petroleum refineries begin operating, and ammonia, which will be supplied by the National Steelworks, all necessary materials are available near the site. Sea water will be successively concentrated to 10-25° Baumé in pans and tanks, exposed to the sun, and the salt will be crystallised in vacuum evaporators. Lime is to be obtained by suction dredgers from the abundant shell deposits in the adjoining lake, processed on the dredger, transferred to lighters and thence to conveyor belts, which will discharge it into the factory's silos. Fresh water will be drawn from the river nearby and water for cooling purposes from the sea. Manufactured products are to be carried by aérial cable to the port, while liquid caustic soda will be pumped aboard through pipelines.

Domestic consumption of caustic soda and barilla is increasing at the rate of 10 per cent yearly and requirements in 1952 are estimated at 100,000 and 70,000 tons, respectively. To meet a larger part of future needs Companhia Nacional de Alcalis will subsequently raise capacity to 200,000 tons of carbonate of soda annually, leaving the balance to be produced by private enterprise.

French Coal Tar Film

AT THE invitation of the British Tar Confederation and the British Road Tar Association a large gathering of technical Press and trade representatives attended the first showing in this country of a sound film in colour on the French Coal Tar Industry at the Royal Empire Society's rooms on 20 October.

The film was introduced by M. Lozet who was speaking in the absence of M. Solile, president of the Comité Intersyndical des Goudrons, Benzols et Dérivés, sponsors of the film. He said that unlike Great Britain, France had not as yet developed to the maximum the use of tar and benzole and for this reason the Comité had decided to publish a film giving the man-in-the-street an opportunity of seeing the part the tar and benzole industries were playing and could play in the economic life of the nation.

'Le Goudron Houille-Richesse Nationale' runs for an hour with French commentary and covers coal carbonisation, tar distillation, chemical derivatives and some of their uses, tars obtained by special preparation and concludes with illustrations of the properties of tarmacadam.

Sulphur Consultants

The formation of S. Schwartz & Associates, consulting engineers, has been announced by Seymour Schwartz, president of the firm of chemical engineers and economists. Mr. Schwartz's organisation will specialise in the field of sulphur processing and recovery with headquarters located at 165 Broadway, New York City. Believed to be the only company specialising in this field, S. Schwartz & Associates will provide technical designs, improvements and economic evaluations for various industries concerned with the use and processing of sulphur, sulphur-bearing materials, and the recovery of sulphur from sour gases.

Indian Newsletter

FROM OUR OWN CORRESPONDENT

INVESTIGATIONS by the Geological Survey of India have revealed large quantities of high grade bauxite in the hilly regions of the Bilaspur district in central India. The ore averages an Al_2O_3 content of 58 per cent, with a low silica content, which is considered to be a chief merit. The bauxite is titaniferous with about 8 per cent titania. It might be recalled that the Council of Scientific and Industrial Research in India developed a process some time back for the recovery of titania from bauxite and that process may come in handy for the Bilaspur deposits.

The deposits occur on top of high hills and have a thin overburden of laterite which should render mining operations relatively easy. In other places, the deposits are exposed where it is believed to be only a question of collecting the material. However, the problems such as accessibility, transport and labour are receiving due attention before commencement of mining on the site.

* * *

The Sindri Fertilisers and Chemicals, Ltd., have recently concluded an agreement with the Associated Cement Companies, Ltd., for the sale of 900 tons of chalk per day at Rs.9 a ton. Sindri commenced working this year and produces ammonia sulphate by reacting under pressure gypsum and ammonium carbonate. The calcium carbonate sludge resulting from the process will henceforth be used as a raw material for the manufacture of cement. For this purpose the company will shortly install a cement plant at Sindri at a cost of Rs.15 million. The plant is expected to go into production in two years; it will initially produce 300 tons of cement per day and will gradually boost the output to 600 tons per day.

The Government of Madras are currently interested in producing cheap phosphatic fertilisers from the phosphatic nodules found in considerable quantities in Trichinopoly district. It is learnt that the process of calcination with silicate fluxes that is successfully used in TVA is receiving the attention of that Government.

* * *

The Ministry of Supply of the Government of India announced recently that the Government were considering setting up chemical industries in the country using salt as the raw material. India, until two years back deficit in salt, has now reached a surplus in substantial quantities. She is to export 7.5 million tons of salt to Japan by the end of the current year and already about 4 million tons have been shipped. With the enormous increase in output of salt in India, while a certain amount will be earmarked for export, the Government desire to establish new industries to utilise the salt produced in the country. The Government at the moment are concentrating on improving the quality of the salt and to this end are shortly to establish a salt research laboratory at Bhavnager in western India. Besides this there would be six regional salt research stations.

* * *

A scheme for setting up two creosoting plants to give preservative treatment for railway sleepers is shortly to be implemented. The scheme envisages the setting up of two new plants, one near Bareilly (U.P.) and the other at Coimbatore (Madras), the estimated costs being Rs. 4,100,000 and 1,400,000 respectively.

* * *

The geophysical survey in search for oil in the rocks under the Bengal alluvium conducted by the American Standard Oil Company has already appeared 'promising enough for this company to start negotiations with the Government of India regarding the terms and conditions for the exploitation of oil in that region.' This was disclosed at a recent meeting of the Geological Mining and Metallurgical Institute of India.

Plastic Pipeline in Australia

Plastic pipes for spray irrigation of orchards are being considered by South Australian water-supply experts. Galvanised iron pipes last only about six years in South Australia; the plastic types have a stronger resistance to corrosion, and are lighter and easier to join. Butyrate materials, imported from the U.S.A., are being used by Australian plastic manufacturers for these pipes.

Metallurgical Section

Corrosion Investigation During 1951

Progress at the Chemical Research Station

THE Corrosion of Metals Group played a prominent part in the work of the Chemical Research Laboratory, Teddington, during 1951. A satisfactory feature was the extent to which fundamental investigations contributed to the solution of practical problems.

Consistent progress was made in the several branches of the Group's activities, of which soil corrosion has become an integral part. Investigations which were divided under four main heads—Immersed Corrosion Section, Corrosion of Buried Metals, Study of Surface Films, and Atmospheric Corrosion Section—are described in the report of the Chemistry Research Board, which with the report of the director of the Chemical Research Laboratory, is contained in 'Chemistry Research, 1951,' published for the Department of Scientific and Industrial Research by HMSO, price 4s. 6d. (U.S.A. $1.15).

Work on Rotor Techniques

In the Immersed Corrosion Section work was continued on high and low speed rotor techniques. The influence of sea water additions to distilled water on the corrosion rate of mild steel in stagnant conditions at 25° was studied, using the oxygen absorption apparatus. The results were consistent with those obtained in earlier work.

Previous investigation had shown that sodium salts of *o*-, *m*-, *p*-nitrocinnamic and *o*-nitrohydrocinnamic acids, at concentrations of 0.5-1.0 per cent, inhibited the corrosion of zinc in distilled and mains water at room temperature and at 80°. Further work revealed that these salts had the property of inhibiting the corrosion of cast iron in similar conditions. At 0.5 per cent concentration in mains water at room temperature they conferred partial protection. At one per cent concentration complete protection was obtained in some cases.

It was found, however, that one per cent solutions of some of these salts, as prepared, had a *p*H of 11. This *p*H would tend to assist the inhibition. However, a test carried out using the 'boiling tube technique' (intermittent heating at 80° and cooling) with solutions initially at a *p*H of about 8-9 confirmed the results obtained at room temperature with solutions of higher *p*H.

Boiling Tube Test

For copper the 'boiling tube test' in these solutions gave results that were not very conclusive, as the maximum weight loss was only 13 mg. on the 'control' specimen in mains water. No attack beyond tarnishing and discolouring was observed with any specimen.

The effect of these compounds on the corrosion of galvanised iron in mains water was investigated (at room temperature). An outstanding observation was that, following an initial period of attack on the zinc only, specimens in the sodium benzoate solutions rusted at the cut edges where the ferrous metal was exposed. The results suggested a reversal of polarity in the presence of benzoate; the effect of concentration of sodium benzoate on this reversal was investigated.

Electrode potential measurements on separate zinc and steel specimens in distilled and mains water, with and without sodium benzoate additions, had so far revealed no reversal of polarity between zinc and steel.

Duplicate specimens of emeried zinc sheet 3.2 cm. square were totally immersed (top edge 1 cm. below surface) in mains water containing additions of borax. Complete protection was achieved only with the 1.5 per cent and 2.0 per cent solutions. With 0.1 per cent the weight loss was much greater than in the control and serious local attack occurred. With increase of concentration the intensity of local attack diminished with a corresponding decrease in the total attack.

The mechanism of the corrosion-inhibitive action (in non-acid solutions) of salts such

as potassium chromate and sodium benzoate was investigated. Electrode potential measurements on steel specimens immersed in aqueous solutions of these salts had indicated that the benzoate, like the chromate, could be classed as an 'anodic inhibitor.' Subsequent work had confirmed these results. It was shown, however, in early experiments with sodium benzoate that this inhibitor differed from chromate in one important respect.

When benzoate was present in a concentration that was insufficient to confer protection, corrosion usually became widespread and uniform, with absence of localised attack or pitting. By contrast, chromate was a 'dangerous inhibitor' because, when the concentration was barely sufficient for protection, localised attack might be produced. This suggested that the two inhibitors differed in their mode of action, which was later borne out by tests.

Study of Corrosion Inhibitors

Among the new projects was the application of radioactive tracer techniques in the study of corrosion inhibitors. For this potassium chromate containing ^{51}Cr was employed, and the work had led to the conclusion that the rôle of the inhibitor was not solely that of an oxidant keeping the iron oxide film in repair. The technique had already furnished information on the amount of chromium in the protective film and the distribution of the chromium over the surface. The use of electrode potential decay curves had thrown further light on the mechanism by which sodium benzoate and potassium chromate inhibit corrosion.

Electrochemical investigation of the behaviour of painted steel panels in solutions of various osmotic pressures was continued, using sucrose in place of sodium chloride. The relationship between osmotic pressure and water uptake was found to be similar to that in sodium chloride solutions, and in good general agreement with the results obtained gravimetrically by Kittelberger and Elm. This further confirmed the validity of the electrical method of measuring the water uptake.

In sucrose solutions (i.e., in the absence of sodium chloride) no rusting of the underlying metal occurred; the capacitance/time curves continued to rise slowly in 0.1 molal solution, presumably because of continued water absorption, but became horizontal in more concentrated solutions.

Paint breakdown (with corrosion of the underlying metal) soon occurred in the presence of sodium chloride, but it was preceded by a rapid rise in the capacitance/time curve. It was doubtful whether a quantative relationship could be established between the chloride ion concentration (at constant osmotic pressure) and the time before paint breakdown, because the sucrose appeared to retard the corrosion of the underlying metal.

Four model Scotch marine boilers were installed on behalf of the British Shipbuilding Research Association for investigating the corrosion produced in boiler tubes by the infiltration of salt water. Advice on the corrosion of boiler tubes in generating stations was also given to the British Electricity Authority.

An unusual study in the Corrosion of Buried Metals was the examination of some iron and other metallic objects found on an archaeological site at York. Remarkably little corrosion had occurred on these articles, which had apparently been buried in waterlogged peaty clay for more than 1,000 years.

Preservation of the metals, it was considered, might be the result of the protective action of phosphates and tannates identified in the soil samples and in the coating of one of the objects. More detailed examination of further soil samples should yield valuable information on the factors favouring the formation of protective films in otherwise aggressive conditions.

Study of Surface Films

Primary object of the Study of Surface Films was to obtain experimental results which might be used to formulate or test theories on the oxidation of metals at temperatures below about 250°C. At these temperatures the thickness of the oxide films that grow on the surfaces of metals such as copper is quite small, within a few hundred Ångstrom units, so that the experimental work must include a study of the physical and chemical nature of the surface employed. At present electrolytically polished surfaces of polycrystalline copper sheet of high purity were being studied.

In the Atmospheric Corrosion Section tests had been begun using units of the 'Beaker Type' accelerated corrosion appa-

ratus as part of a co-operative scheme among members of the Institute of Petroleum Protectives Panel, each using the CRL apparatus (as produced commercially). Steel specimens coated with the 11 temporary protectives, previously examined under sheltered outdoor conditions, were being tested. Correlation of the result of laboratory tests with those outdoors was, so far, very promising.

A differential thermostat had been operated over a temperature range of 50°-100° to determine the corrosion rates of mild steel under conditions when slight condensation occurred. A preliminary curve of loss in weight after de-rusting, plotted against the temperature showed a maximum value between 80° and 85°; the ratio of gain in weight (rust products) to loss in weight (steel corroded) varied over the range of temperature examined, as did the colours of the corrosion products (from yellow at lower temperatures through brown to black at higher temperatures).

This change in colour had been measured by a light reflection meter, the loss in total reflection was approximately in direct proportion to the rise in temperature up to 90°. Above 90° there was a slight rise in the reflection characteristic.

Glass Vessels Used

The differential thermostat with which the foregoing results were obtained incorporated an inner and outer (thermostat) vessel of copper. These had now been replaced by glass vessels so that the onset and course of corrosion could be followed visually. The use of a glass inner vessel would enable the experimental range to be extended to cover the use of sulphur dioxide or similar corrosive solutions.

In addition to their use in packaging, vapour phase inhibitors may have a practical application in checking corrosion in closed installations that are temporarily out of use.

A series of laboratory tests undertaken showed that cyclohexylamine carbonate was efficient in reducing to a very low rate further corrosion of previously rusted specimens (reductions of approximately 90 per cent and 95 per cent for SO_2-rusted and chloride-SO_2-rusted specimens); they suggested a promising application of the substance in closed systems (e.g., idle boilers) carrying ferrous materials that have become rusted.

An apparatus had been designed by Metallurgy Division, NPL, in collaboration with Chemical Research Laboratory to investigate the fundamental aspects of the oxidation of low alloy steels, with reference to their use in superheater tubes for modern power plants. The research project was initiated by the British Electrical & Allied Industries Research Association. Commencement of work on the research had been delayed owing to lack of accommodation and staff.

The Radiochemical Group

The Radiochemical Group continued to be mainly concerned with the analysis of minerals and ores and the development of methods for the extraction and recovery of uranium and other valuable metals from low grade ores. Separation by chromatography had been extended to a wide range of metals, including niobium, tantalum, gold platinum, iridium and so on. Metals such as gold, nickel, iron and cobalt had been separated from solution by ion-exchange resins. This process appeared to have a commercial future.

Information on the supply of metals of high purity was collected by the Pure Metals Committee, and stocks of 23 metals were now held for issue to research workers. The problem of producing some metals in the state of purity required for research—notably chromium and titanium—had still to be solved.

Plastic Coverings for Banana Plants

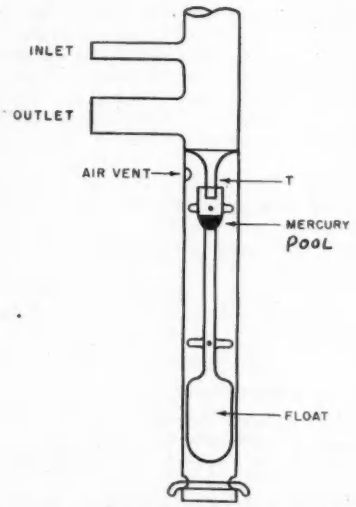
About 20,000 bunches of Australian bananas in the State of Queensland will come to maturity this year in plastic bags, some coloured blue, green and yellow, others white and translucent. The growers put the plastic covers over the bunches about three or four weeks after they break out of the plant, and they are left there until the fruit is ready for harvesting. Last year's experiments showed that covering the fruit in this manner resulted in an increase in the weight of the crop yield by about 25 per cent. The idea is not new. Before the war many growers used hessian, which increased yields by about 12 per cent, but hessian became unprocurable during the war.

Constant-Level Device

U.S. Leveller for Electroplating Baths

DESIGNED primarily for small installations, but expected to prove equally useful on large-scale equipment, a new, easily constructed device for maintaining a constant liquid level in laboratory apparatus has been developed by the U.S. National Bureau of Standards by D. E. Couch and Abner Brenner. The new leveller uses a water inlet and an overflow, or outlet pipe, to maintain a constant head.

In construction the device takes the form of a vertical tube with inlet and outlet connections near the top. Just below the outlet connection the tube is sealed off except for a smaller-diameter open tube which extends below this point, connecting the upper section of the larger tube with the lower.



Schematic diagram of the new device

An open cup of mercury is supported below the small connecting tube by a float which rises and falls with the liquid level in the lower section of the larger tube. When the bath level rises, the float also rises, causing the mercury cup to seal off the lower end of the small connecting tube. All of the water entering through the inlet is then rejected and is eliminated through the outlet connection. When the bath level drops, the float descends, taking with it the mercury cup, and the water runs into the bath through the small tube.

Levellers of this kind can be made in any size, for solution depths of 10 cm. or more. None of the dimensions are critical. The tube should, however, be of sufficient size to prevent it becoming clogged by the small particles of sediment that may enter with the tap water, and the mercury cup must be large enough and so centred that it will slide freely up over the small tube without touching. A convenient diameter for the larger tube is 25 mm. In order for the water to flow freely, the overflow tube should be about 2 cm. in diameter and the float should have about 3 mm. clearance with the surrounding tube.

Scientists at the Bureau of Standards have successfully used one of the new levellers on a 6-litre bath operating at 85°C., and another has been used with a chromium-plating bath of commercial size. Both functioned satisfactorily for several months, maintaining liquid levels constant to within 5 mm.

Although several devices for maintaining a constant level of liquid in tanks are commercially available, none is satisfactory for use with small laboratory setups, such as electroplating baths operated at elevated temperatures. They usually employ a siphon arrangement which is not adaptable to plating baths.

Specification Revised

The specification for heavy duty electric overhead travelling cranes, published by the British Iron and Steel Research Association in May, 1950, has been revised in the light of operating experience, and amendment slips are available free of charge from the Association's information section, 11 Park Lane, W.1. The amendments relate chiefly to a re-assessment of the forces arising from acceleration and braking which the cranes shall be designed to withstand and a closer definition of some permissible stresses; tolerances for standard crane couplings; provision of EM shunt brakes with rectifiers on A.C. cranes; the provision of cross-travel conductors on certain cranes for subsequent fitting of magnets, and the clarification of the main control gear layout diagrams.

FULMER RESEARCH INSTITUTE

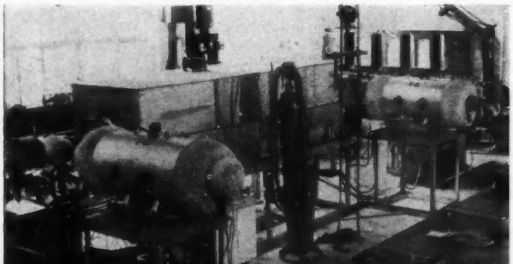
SOME of Britain's most brilliant discoveries in the field of pure research have been ignored until applied to industrial processes and materials overseas. One reason for time-lags in the application of scientific advances to manufacturing techniques is the high cost of research, which is making it increasingly difficult for medium or small firms to maintain well equipped laboratories in which really effective work can be undertaken. For many years the late Col. W. C. Devereux, managing director of the Almin group of alloy factories, was convinced that the general level of industrial efficiency would be improved if it were possible to hire the services of a fully established research team, as one calls in an accountant, an architect, or any other specialists. He therefore decided to invite British industrialists to join him in founding an independent institute to carry out sponsored research.

This movement culminated in the formation of the Fulmer Research Institute with Col. Devereux as its first chairman. A site was acquired at Stoke Poges, Bucks., where an Edwardian mansion was converted into laboratories and workshops, and the Institute was officially opened by Sir Stafford Cripps on 2 July, 1947. On 30 September, 1952, an open day was held to mark the completion of the first five years of work and it was attended by 260 industrialists, scientists and members of the Government. A high purity aluminium plaque erected in memory of the founder was unveiled by Sir Archibald Rowlands, Permanent Secretary to the Ministry of Supply. Speeches were made by the Director of Research, Mr. E. A. G. Liddiard, Sir David Brunt, Sir Frederick Handley Page, and Lord Waverley.

The establishment of the Institute has been described as 'an enlightened experiment' and an 'act of faith.' The results achieved in five years of operation show that it is helping to fill a very real gap in British research. Its yearly income has nearly trebled and its staff has more than doubled. Eight-eight patents, both at home and abroad, have been applied for on behalf of sponsors, who now exceed a hundred. Among the sponsors are the Admiralty; various branches of the Ministry of Supply including the Atomic Energy Research Establishment, the National Gas Turbine Establishment and the Royal Aircraft Establishment; British Railways; a number of Research Associations; many leading industrial concerns such as Rolls-Royce, Ltd., Distillers Co., Ltd., and Morgan Crucible Co., Ltd.; and the largest aluminium-producing companies in Canada and the United States.

Although a high proportion of the Institute's work has been for Government Departments, there has been a satisfactory and steady growth of industrial sponsorship from both home and overseas. British industry contributed 36½ per cent of the total income for the first five years, a further 11¼ per cent consisting of direct dollar earnings from Canada and the United States. Through the contacts established in the United States the Institute is able to offer its British sponsors the possibility of exploiting their research results on a much wider scale than would be possible if its activities were confined to the Commonwealth.

All results arising from research, including the patents, belong solely to the sponsors.



The pilot plant for the catalytic distillation of aluminium

No dividends are distributed to shareholders, any excess income over expenditure being ploughed back to provide greater or improved research facilities. The Institute is staffed and equipped primarily for research on metallurgical problems, but does not confine itself entirely to this field. Its facilities include chemistry, physics, engineering and metallurgical laboratories, all of which are equipped for highly specialised research, together with ceramics and heat treatment departments and a comprehensive library. Much of the Institute's apparatus has been constructed or adapted in the laboratory workshops, which are equipped with a complete range of machine tools, including a universal miller and grinder and three precision lathes.

Many of the researches undertaken at Fulmer cannot be described in detail because the results are confidential to the sponsors. Nevertheless, an impressive indication of the practical benefits resulting to industry was afforded by the exhibits seen in the laboratories during the open day. Particularly interesting is the Institute's work on the extraction of metals by the decomposition of halides, which is based on an entirely novel method of approach—one process which has been devised is known as 'catalytic distillation' and is based on the formation of an unstable subhalide.

From a consideration of spectroscopic data and observations on the distillation and subsequent condensation of aluminium in the presence of cryolite, Dr. P. Gross deduced that aluminium must form monovalent halides at high temperature and low pressure and that the reversible reaction $2\,Al + AlX_3 = 3\,AlX$ (where X is a halide) could be used to distil aluminium by bringing the vapour of the trivalent halide in contact with the aluminium-bearing material at high temperature and low pressure, and then cooling the resulting vapour of aluminium monohalide to condense the aluminium and re-form the vapour of the original trivalent halide. To be commercially feasible it is necessary for the aluminium and the halide to condense at widely different temperatures. If aluminium chloride is used this condition is met, and Dr. Gross went on to prove experimentally that if aluminium trichloride vapour is led over impure aluminium a condensate of high purity aluminium can be obtained. An experimental plant for catalytic vacuum distillation has been in operation at Fulmer for over two years and is capable of producing up to 2 lb. of aluminium per hour, a purity of about 99.97 per cent being achieved.

The process may be used for purifying scrap or aluminium of commercial purity, or for the extraction of aluminium from alloys produced by direct thermal reduction in the arc furnace. On a laboratory scale it is now being applied to drosses with quite encouraging results. Aluminium chloride at a pressure of a few mm. is passed over the dross and the products are cooled, the condensate being aluminium of high purity. This experiment is carried out in a quartz tube. The aluminium chloride is placed in a steel tube, which is closed at one end and attached at the other end to an alumina tube containing briquettes made from the dross. A furnace at the closed end of the quartz tube heats the aluminium chloride to about 150° C. A second furnace at the centre of the quartz tube maintains the dross at about

1,000°C. The alumina tube containing the briquetted dross projects into the cooler portion of the quartz tube and in this region the distilled aluminium condenses. The aluminium chloride condenses at a still lower temperature in a tube made from nickel foil, which is attached to the alumina tube. A specimen of aluminium extracted from dross by this process had a purity rather better than 99.9 per cent. Further laboratory work is in progress under the joint sponsorship of Aluminium Laboratories, Ltd., and International Alloys, Ltd.

By another method—i.e., that of the intermediate formation of its stable halide—beryllium has been distilled at temperatures far below those at which its vapour pressure is sufficiently high for its direct distillation. Sodium chloride vapour at a pressure of about 0.1 mm. is passed over pieces of impure beryllium material at temperatures around 1,000°C.-1,100°C. in an evacuated tank, the following equilibrium being established: 2 NaCl (vapour) + Be (solid) $\rightleftharpoons$ $BeCl_2$ (vapour) + 2Na (vapour).

The products pass into a cooler region of the tube in which this reaction reverses, causing metallic beryllium to condense. At a still lower temperature the sodium chloride condenses admixed with a proportion of beryllium. The metallic beryllium which condenses separately is in general purer than the material originally used, since oxides, carbonates and many metallic impurities present do not take part in the finished reaction. The process thus enables beryllium to be prepared in a highly purified state from quite impure starting material.

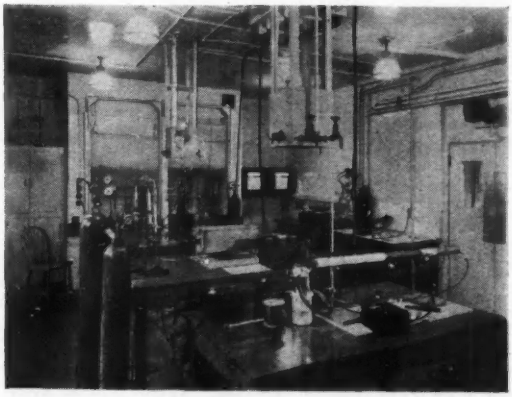
This indirect distillation process can be applied to the extraction and purification of other metals, the choice of halide and reaction conditions being dependent on the particular metal under condensation. A similar method is being used for the extraction of titanium, which is also being prepared by disproportionation of titanium halides and by hydrogen reduction of halides.

In another of the Institute's three vacuum laboratories the vapour pressure of titanium dihalides by a transference method is being studied. A measured volume of dried or deoxidised argon is passed over a titanium dihalide, so as to saturate the gas with dihalide vapour at the temperature of the experiment. The gas then passes over aluminium nickel gauze, thus causing the following reaction to occur:

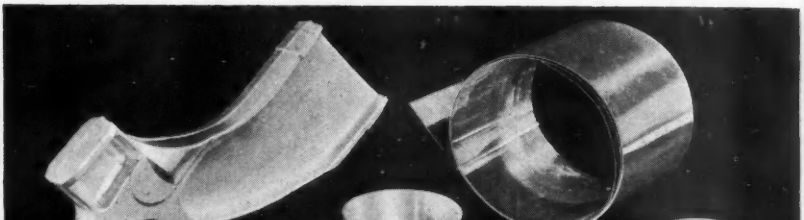
$$2\,TX_2\ (\text{vapour}) + Ni \rightleftharpoons Ni,Ti\ (\text{nickel-titanium alloy}) + TiX_4\ (\text{vapour}).$$

The nickel gauze is subsequently analysed for titanium so that the weight of titanium dihalide vapour passing over it can be deduced. From this the vapour pressure can be found. Since the titanium dihalides decompose or react quite rapidly in the atmosphere, they are prepared *in situ* in these experiments by means of the reaction between excess titanium powder and a lead halide, resulting in the formation of titanium dihalide and metallic lead.

An accurate calorimeter has been designed and constructed for measurement of the heats of reaction and heats of formation of metallic compounds. It has been used for measuring the heats of formation of aluminium fluoride, magnesium fluoride, and



The new physical chemical laboratory



Applications in the new '500' series of aluminium/copper/cadmium alloys in the form of forgings, extrusions and sheet

cryolite. Exhibits on view at the open day included a bomb which had been designed for carrying out exothermic solid phase reactions in an inert gas (argon) atmosphere, the reaction being initiated by means of a tungsten wire embedded in the reaction mixture and connected to batteries. The reaction commences within a fraction of a second when current is passed through the wire, and the heat of ignition is measured by observing the throw of a ballistic galvanometer which is included in the circuit. Temperature changes in the calorimeter bath are measured with a thermistor, this being an element with a high temperature coefficient of resistance. Temperature differences of 0.0002°C. can be recorded by this method, the total temperature change which is usually measured being about 1°C.

Details of the reactions so far investigated are as follows:—

Aluminium fluoride.—A briquette made from the mixed powders of lead fluoride and excess aluminium is ignited and the following reaction occures: $2\ Al + 3\ PbF_2 \rightarrow 2\ AlF_3 + 3\ Pb$. The heat of reaction is measured, and when this is combined with the known heat of formation of lead fluoride, the heat of formation of aluminium fluoride is obtained.

Magnesium fluoride.—The heat change occurring in the following reaction has been measured:—

(a) $3\ Mg\ (excess) + PbF_2 \rightarrow MgF_2 + PbMg_2$

(b) $Mg + PbF_2\ (excess) \rightarrow MgF_2 + Pb$.

Since the heat of formation of $PbMg_2$ is known, two values for the heat formation of magnesium fluoride are obtained.

Cryolite.—The reduction of lead fluoride by aluminium is carried out in the presence of excess sodium fluoride, the reaction being as follows:—

$2\ Al + 3\ PbF_2 + 6\ NaF \rightarrow 2\ Na_3AlF_6 + 3\ Pb$.

From the heat of reaction, the heat of formation of cryolite can be obtained.

This method with some modifications is being applied to measurements on titanium dihalides.

For these experiments lead fluoride of very high purity is required, and it is particularly necessary that it should be free from traces of moisture which are usually present, even after the salt has been heated quite strongly in a vacuum. At higher temperatures the moisture causes hydrolysis of the salt and this can only be avoided by heating in a stream of anhydrous hydrogen fluoride. Purification is therefore carried out by melting the lead fluoride in a stream of pure anhydrous fluoride, replacing the hydrogen fluoride by purified argon, and cooling. The cooling is carried out in argon to avoid absorption of hydrogen fluoride by the solid. Since lead fluoride melts at about 850°C., it is heated in a platinum boat placed in an alumina tube heated by an electric furnace.

Another Fulmer team has done outstanding work on high temperature materials and in alloy developments, particularly in the

light alloy field. Research under the sponsorship of the Tin Research Institute has led to the development of new aluminium bearing metals containing about 30 per cent of tin. From research work sponsored by the Ministry of Supply came the aluminium/copper/cadmium '500' series of high strength alloys, which are the direct result of an important fundamental study in both the Physics (X-ray) and Metallography Sections of the mechanism of age hardening of aluminium/copper alloys and the influence of third elements.

The Institute's investigators have also carried out a large number of special testing programmes, often with apparatus specially designed and constructed at Fulmer. For the textile industry they have analysed scientifically the friction and wear between yarns and metals. By means of special strain gauges they have measured the relative movement between the old and new sections of a hydro-electric dam, and they have studied the behaviour of numerous engineering materials at temperatures up to 1,000°C. The work has ranged from straightforward investigations to studies of such abstruse phenomena as oxy-ethylation of wool wax alcohols, hydrogen embrittlement of steels, properties of metal ceramic aggregates, creeps of metals, and viscosities of molten slags. Although the results of individual investigations are the properties of the sponsors, the knowledge gained at Fulmer will benefit a very wide cross-section of British industry.

The growth of staff and research income has necessitated increases in laboratory facilities and equipment. Increased laboratory space for physical chemistry and calorimetry was recently provided by transferring the canteen from the main block to a separate building. Plans for the erection of another single-storey building to provide a new mechanical testing, creep and engineering laboratory are now well advanced.

Analysis of Iron & Steel

TWO new parts of the British Standard for Methods for the Analysis of Iron and Steel (B.S. 1121) have recently been published.

The method of determining vanadium in ferro-vanadium (part 25), is by solution of the sample in sulphuric and nitric acids and oxidation of the vanadium to the quinquivalent condition with potassium permanganate. Excess of potassium permanganate is reduced with sodium nitrite, and sulphamic acid is used to destroy the excess of nitrite. The oxidised vanadium is titrated with ferrous ammonium sulphate and potassium dichromate, using barium diphenylamine sulphonate as an indicator.

In the determination of molybdenum in low alloy steels containing up to 0.5 per cent tungsten (part 26), the principle of the method used is precipitation of the molybdenum from a hydrochloric acid solution of the sample with *alpha*benzoinoxime. The precipitate is re-dissolved and molybdenum, after conversion to thiomolybdate, is separated as sulphide from a solution in which the precipitation of tungsten is prevented by the presence of tartrate ions. The sulphide precipitate is ignited and weighed as molybdic oxide.

Copies of these standards may be obtained from the British Standards Institution, Sales Branch, 24 Victoria Street, London, S.W.1, price 2s. each.

Welding & Distortion

Presidential Address Delivered in London

DISTORTION in welded work was the subject chosen for his address as incoming president by A. Robert Jenkins, A.I.Mech.E., at the meeting of the Institute of Welding held in London on 8 October.

Comparatively little had been written on this subject, said Mr. Jenkins, probably because so many variables affecting distortion were encountered in shop practice and technique; these variables gave rise to very mixed results which made it extremely difficult to arrive at a common basis on which to fix reliable rules.

Variables which had to be considered in relation to this problem were:—

(1) Type of material and thickness; (2) method of preparation of plate edges; (3) design; (4) amount of restraint on plates during welding; (5) accuracy of set-up; (6) type of electrode; (7) size of electrode and current; (8) rate of deposit; (9) number of runs; (10) manual or automatic welding.

Distortion was produced by shrinkage, the degree of which could be affected by all the variables mentioned. Shrinkage was the

residual contraction in volume of the metal after cooling, and distortion ensued if the temperature distribution had not been uniform, as was the case with arc welding.

Starting with the results of shop tests designed to show the extent of transverse and longitudinal shrinkage, Mr. Jenkins went on to discuss practical methods of preventing and reducing distortion, of counteracting it when it had occurred, and of controlling it by staying and strutting.

Finally a description was given of how low welded vessels which, through accident, having been distorted almost beyond repair, were made usable again by special treatment.

Sulphate of Copper

Association's Annual Meeting

THE 28th annual general meeting of the British Sulphate of Copper Association Limited was held at the Association's Offices at No. 1 Great Cumberland Place, London, W.1, on 22 October, the chairman, Mr. J. D. McKechnie, presiding.

Opening the meeting, the chairman said: 'Notwithstanding a bad start, due to the continued shortage of raw materials, the season finally turned out far better than had been expected; our sales were up by about 16,000 tons and were an all-time record for the association.

'Production during the first half of the seasonal year was down compared to the previous year, but after supplies of raw materials had eased in the New Year, it was raised and by the end of July total production was up on the previous season.

'Copper continued to rise during the year, and consequently at the end of the season the price of sulphate of copper was higher than it had ever been. Generally speaking, such a high price is detrimental to its use, particularly by farmers, and the sooner we can bring it down to lower levels the better it will be for our sales in both home and export markets.

'Exports were about 500 tons up on last year—45,237 tons against 44,764—the demand being exceptionally good in spite of high prices. Home sales were also higher, due equally to increased agricultural and industrial use.

Early in the season there were signs of increasing supplies becoming available from other exporting countries and during the latter part of the year we found buyers more cautious owing to easier conditions in various other commodities.

'With regard to this season's prospects, our supply position is likely to be better, but this applies equally to our competitors. Unfortunately it seems unlikely that we will be in the same position as some of our foreign competitors in regard to prices of raw materials. The domestic price of electrolytic copper in the U.S.A. is £89 per ton cheaper that it is in this country.

'We must expect increasing competition in our export markets this year and it is, therefore, essential that we should not only be able to obtain raw materials as cheaply as our competitors, but that our other manufacturing costs should be kept down. This will not be possible if the continual demands of the past few years for wage increases are not moderated.

'It is to be hoped that bulk buying of copper will soon come to an end and that the Metal Exchange will be reopened for dealings in copper, thus enabling the sulphate manufacturers to cover their forward sales, as they used to do before the war and which was a great help to business.

'As far as research is concerned, regular visits have been made to Agricultural Research Stations in the U.K., and it is interesting to note that, as a result of intensified research into diseases of crops and animals caused by copper deficiency in this country, the importance of the use of sulphate of copper to counteract them is being realised.

'I should like to stress the importance of sulphate of copper as an export in the economy of the country. For example, the value of our exports last season was just over £4,500,000 and for the first eight months of this calendar year it was greater than that of any other chemical except ammonium sulphate. Twenty-one per cent of the value of our total exports last season was for dollar sales, the value of which was only very slightly down on the previous year.'

Greef-Chemicals Holdings, Ltd.

An interim dividend of 3¾ per cent less tax on ordinary shares for the year ending 31 December, 1952, payable on 1 November has been declared by the directors of Greef-Chemicals Holdings, Ltd., to shareholders on the register at the close of business on 9 October, 1952.

Productivity in Steelmaking

BISRA Conference Discusses Productivity Report

THE recommendations of the report of the Iron and Steel productivity team, published on 30 June, are to be thrashed out in a series of technical conferences organised by the British Iron and Steel Research Association, the Iron and Steel Institute and local Metallurgical Societies. This procedure is being followed at the request of the three bodies to whom the report was presented: the British Iron and Steel Federation, the Iron and Steel Trades Confederation and the National Union of Blastfurnacemen.

The first of these conferences was held by BISRA at Ashorne Hill on 1 and 2 October, to discuss the report's observations and recommendations on steelmaking. Dr. T. P. Colclough (British Iron and Steel Federation) was in the chair, assisted by Mr. R. W. Evans (Steel Company of Wales, Ltd.). There were 114 delegates to the conference (excluding BISRA staff), from 35 steelmaking companies, representing over 90 per cent of the open hearth steelmaking capacity of Great Britain.

Report Introduced

Discussions were opened by three members of the Productivity Team. Sir Charles Goodeve, the leader, introduced the report and spoke on 'The Size of British Steelworks: Recommendations for the Future.'

Dr. D. F. Marshall, of the Park Gate Iron and Steel Co., Ltd., spoke on 'Open-Hearth Productivity and Fuel Consumption: Main Factors Calling for Action.'

Mr. D. Kilby, of Colvilles, Ltd., spoke on: 'Open-Hearth Practice in America: Possible Applications to British Practice,' and on 'Furnace Availability.' This article presents a summary of the proceedings.

The keynote of the Conference was set by Sir Charles Goodeve, in his introduction, when he said that the hard fact that emerged from the report was that productivity in the U.S.A., whether measured by man hours or by furnace productivity, was higher than in the U.K. by a factor of two. This presented a serious and stimulating challenge to the steel industry of Great Britain and to the Conference in particular.

In discussion on how far the productivity gap between American and British furnaces was a real one and could be lessened, much comment naturally turned on the lighter metallurgical load carried by American furnaces. With copious supplies of consistently low-phosphorus iron, and high grade oil or natural gas for fuel, they carry a far lighter slag than British furnaces. Where 20 per cent and even 30 per cent of slag is commonplace in Great Britain, 10 per cent and 15 per cent of slag is seldom exceeded in the U.S.A. with all the advantages this means in heat transfer to the steel bath and in refining time.

Opinions Differ

Some speakers maintained that the difference to productivity from this factor might be as much as 25 per cent to 35 per cent, and that if British steelmakers could have consistent supplies of iron of even 1 per cent to 1.2 per cent phosphorus, productivity would be raised considerably. Most speakers, however, thought that the difference in productivity attributable to raw materials supplies was more likely to be in the neighbourhood of 10 per cent. Results from the operation of the 200-ton furnaces at the Abbey Works were quoted to show that these furnaces, of predominantly American design operating on the ordinary raw materials of British practice, were giving an average weekly output, on unbroken weeks, of over 2,800 tons per furnace, with a fuel consumption of 19.47 gallons per ton. This was parallel with the best American practice despite a high metallurgical load.

Consideration of what British steelmakers might do under American conditions was rightly felt to be unrealistic. Discussion centered on what could be done to get the greatest advantage from the adoption of larger units and what measures could be taken to increase productivity from existing units.

More large tilting furnaces with suitable semi-active or active mixer ancillaries were seen as one contribution. Duplexing was also discussed, and it was pointed out that the best size of open hearth furnace for this process was not determined. The average time of a duplexed heat is 4½ hours and very

large outputs can be achieved. But it is, generally speaking, only economic if, as the report states, the price of iron is not much higher than that of scrap, and it was suggested that the reason why duplexing is not more widely used in this country is economic rather than technical. Even so, one large open hearth melting shop in the North Eastern area is being equipped with acid convertors for duplexing.

One speaker suggested that the basic Bessemer process itself might be more economic than the large open hearth furnaces either fixed or tilting, where iron quality was beyond a critical value, in spite of the larger iron losses inherent in the process. The so-called turbo-hearth process and its offshoots with oxygen-enriched blast could decrease this disadvantage.

Productivity Discussed

Increasing productivity of existing plant was, however, the chief preoccupation of most speakers in the discussion. Successful practice at the Abbey Works was described as partly due to adoption of American methods of charging by ground charger from stage bogies. It was possible to charge the 269 tons (112 tons of scrap, 112 tons of hot metal, 25 tons limestone, 20 tons of ore) in three hours. Single flow checkers with top temperatures of 1,250 to 1,400°C. were used and it was felt that air preheat was a cardinal factor both in production and in economy. Fuel practice was to burn up to 525 gallons per hour until the charging of the hot metal was completed, the furnace being operated on an air/fuel ratio control with ten per cent excess air, and a pressure control of 0.1 in. positive water gauge. After charging hot metal, fuel input was reduced to 250 gallons per hour with 25 per cent excess air and later to 150 gallons per hour. Hearths are partly insulated and have retained some heat a fortnight after the furnace has gone off. There are two roof temperature pyrometers and the temperature is kept at 1,650°C. by manual control. Roof life to the first patch (at the back of the furnace) is seven weeks and the patch is installed in approximately eight hours; this lasts three to four weeks. Sometimes the roof will stand a bad patch giving a further three weeks' life or a total roof life of 13 weeks. Refractory consumption is about 30 lb. per ton.

Warming up practice is not as fast as in America but is faster than that common in this country. From dead cold to first charge at Abbey Works takes about forty hours.

Perhaps the most important difference between American and British practice in the use of refractories is the attitude to roof life. In the U.S.A. the life of the open hearth roof is not considered to affect the producing power or availability of the furnace to a major extent. The roof can be replaced in a very short time as compared with the time required to replace other parts. The roof in fact has to adapt itself to the production tempo of the rest of the furnace and this frequently means that by the end of its life a furnace roof will have undergone well over 100 per cent of patching.

American refractory consumption figures are low compared with those of the U.K., partly due to larger furnaces with a lower metallurgical load and partly due to the better refractory raw materials available. The possibility was mentioned that in this country low-alumina silica bricks might close the gap to some extent both directly and by encouraging manufacturers of other refractories to reduce their alumina contents. It was said that if we could get an average porosity of 22 per cent, production could be increased by 10 per cent.

The zebra type of roof construction was common in America and claims of increased production up to 20 per cent had been made. One speaker had had one which lasted for 20 weeks. At the end of 10 weeks the magnesite bricks were standing 'proud' but after that they spalled and finished thinner than the silica bricks. On the whole it was felt that there were possibilities in the zebra construction which might lead to greater U.K. production. Advantages had been gained in both countries from basic ends, but it was clear that all-basic furnaces here were more successful than they were in the U.S.A.

Canadian Iron Discovery

A new iron ore discovery in Labrador has been made by Fort Chimo Mines, it is reported. Discoveries so far have indicated the material can be called a lean, non-Bessemer ore with a combined manganese-iron content of about 50 per cent. According to geologists, it is probable that the finds will run northward for about three miles.

The Chemist's Bookshelf

GLYCOLS. Edited by G. O. Curme, Jnr., and J. Johnston. Reinhold Publishing Corporation, New York. Distributed by Chapman and Hall, London, 1952. Pp. xii + 389. 96s.

This American Chemical Society Monograph (No. 114) has been written by a team of experts from Union Carbide and Carbon Corporation. The senior editor is a vice-president of this company, and pioneered the manufacture of ethylene glycol and derivatives from cracked petroleum gases in the early 1920's.

The book is restricted to the technically important glycols and their derivatives, and contains much unpublished, or otherwise inaccessible information. Ethylene and propylene glycols and oxides and derived esters, ethers and polymers form the main subject matter. Methods of production, physical and chemical properties and technological applications are thoroughly discussed. A brief chapter dismisses glycols which are much less important commercially, but which may become important in the future. There are useful chapters on the toxicology and physiological effects of industrial glycols and derivatives, and on analysis and test methods.

We learn of a successful and unique process for ethylene glycol developed by du Pont's in 1940, which deserved to be better known; high temperature and pressure condensation of formaldehyde with carbon monoxide and methanol gives methyl glycollate, which can be catalytically hydrogenated to ethylene glycol and methanol (recycled). The enormous and growing range of applications of the glycols and their derivatives will surprise many.

The only inaccuracy noted was in a reference to the use of propylene oxide in the manufacture of the analgesic drug amidone; the first step in the process usually employed is the conversion of propylene oxide into 1-dimethylaminopropan-2-ol.

The monograph is printed in the U.S.A., and the printing, paper, and binding are of a high standard; it will be an essential in all research and technological libraries.—W. WILSON.

ANTIBIOTICS—A SURVEY OF THEIR PROPERTIES AND USES. By S. J. Edwards, etc. Pharmaceutical Press, London. 1952. Pp. 274 + ix. 25s.

The book is concerned with antibiotics in use in Great Britain; in the main with penicillin and to a lesser extent with streptomycin, chloramphenicol, aureomycin and terramycin. Some details are also included of the bacterial antibiotics such as tyrothricin, bacitracin and the polymixins. There is a good balance between the historical and the practical. The chapters of historical summary, commercial manufacture and chemistry present an extremely interesting background to the large amount of medical, pharmaceutical and veterinary data included in the publication.

It is only now becoming possible to place in perspective the large amount of research that was undertaken in Great Britain and the United States of America during the war and which remained unpublished until 1949. In view of the large amount of research being carried out on the action of antibiotics at the sub-cellular level of organisation, it is unfortunate that there is not a chapter on this subject. With the rapid growth of the field of antibiotics, such a text requires continual revision and it may be hoped that a future edition will include such a section.

The investigations with penicillin are an excellent example of the interdependence of pure and applied science. At one end of the scale genetical studies are yielding new mutants for greater yields of penicillin and at the other industrial development results in the production of a more pure antibiotic.

The book with its 800-900 references should be an extremely useful aid to all workers who are concerned with laboratory investigation, preparation and use of antibiotics.—K.R.R.

CHEMISTRY OF THE METAL CHELATE COMPOUNDS, By A. E. Martell and M. Calvin. Prentice-Hall, New York, 1952. Pp. 613. 10 dollars.

The importance of metal chelate compounds in analytical chemistry is well known. In recent years other applications have become important and research work has led to a considerable increase in knowledge of these compounds. While the authors state that this book was written because a number of general conceptions arising from their researches demanded expression, it fulfills a definite need for an authoritative and up-to-date book on the subject.

Following an introduction in which co-ordination theory is outlined and terms defined, an account of methods of detecting chelate compounds is given which includes the use of absorption spectra, conductivity, optical activity, solubility, redox potential, polarographic, reaction rate and X-ray measurements. The approach is very good and it is emphasised that in general more than one method must be used before the existence of a chelate is definitely proved. It may be noted that Job's method, mentioned on pages 29 and 72, strictly only gives stoichiometric ratios and not formulae as the text might suggest.

The work of the last decade on the equilibria involved in chelate formation is outlined in a chapter on stability constants which includes a discussion of the methods used in their determination and the evaluation of thermodynamic constants. About one third of the book is devoted to various aspects of the structure of metal chelates. Evidence relating to the number and size of chelate rings, the relation of basic strength and chelate stability, resonance and entropy effects, the nature of the donor atom and the effects of substitution are considered under the influence of the structure of the chelating agent. The influence of the charge and radius of the metal-ion and the correlation of stability constants with the position of the metal in the periodic table and its ionisation potential are discussed together with selectivity, specificity and competition between metals.

There is a useful chapter on bond type which includes the theoretical magnetic criteria of bond type, the experimental results of magnetic measurements and their correlation with absorption spectra. Exchange reactions and the use of the Szilard-Chalmers method employing radioactive isotopes are also considered as methods of indicating bond type. The authors are to be congratulated on providing a very useful critical survey of a large amount of work in the chapter on the structures of chelate compounds. The general principles governing structure are emphasised and many examples cited of results obtained from X-ray measurements, stereoisomerism, magnetic measurements, dipole moments and other methods.

The final third of the book deals with actions and uses of metal chelates. The biochemist will find much of interest in the chapter on catalytic action which includes an account of chelates such as haemoglobin which act as reversible oxygen carriers in body processes. The role of chelation in the action of proteolytic enzymes and the activation of enzymes by chelate formation are also discussed in detail. The use of chelates in the analytical separation and estimation of metals has been extended in recent years by new techniques such as those involving ion exchange and solvent extraction. These techniques are discussed and there is a useful section on the application of solvent extraction to the study of ions in solution.

A final chapter deals with uses of chelating agents, in particular in metal-ion control and metal titration techniques. Other applications include the use of chelates as organic sequestering agents, in the dyeing of fabrics and in biological systems. These uses are admirably summarised by tables. Appendices covering 44 pages include lists of chelate stability constants, a discussion of optical activity and related properties, a short glossary of terms and some thermodynamic constants for metal-chelating agent reactions. The book is extremely well documented, over 800 references being given. It can be confidently recommended to all those interested in the subject. The honours student will find much of interest and the book is likely to be indispensable to the research worker on metal complexes. Binding and printing are good and the price, in view of the large amount of information provided, is not excessive.—W.R.M.

HOME

Cantor Lectures

'Microbiology' will be the subject of the three Cantor Lectures to be given this year at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C. The speaker will be Dr. P. W. Brian, of Imperial Chemical Industries, Ltd., and the lectures will be on Monday evenings, 17 and 24 November, and 1 December, at 6 p.m.

Fish Killed by Pollution

Dead fish, seen floating in thousands, in the river Severn on 28 May were said to have been killed by the release of injurious matter into the waters by a Newtown (Montgomeryshire) firm. The company was on 23 October fined £20 and ordered to pay costs. It was stated that, without realising its contents, a 700-gallon zinc tank containing cyanide solution had been emptied into a drain and had so gone through the public sewers and finally into the river. The firm had accepted all financial responsibility as soon as it heard of the pollution.

Peracetic Acid Bleach

Laporte Chemicals, Ltd., of Luton, Bedfordshire, announce the introduction of peractic acid 40 per cent for the bleaching of nylon fabrics which have become discoloured during the setting process. Peracetic acid, it is said, will produce an excellent and lasting white at economical costs and is not corrosive towards stainless steel, and so fabrics can be bleached in standard dyeing equipment. The manufacturers will be pleased to send further details on request.

Iron & Steel Allocations

The Ministry of Supply has announced that from 1 January, 1953, no distinction will be made in allocation between Alloy Iron and Steel and Non-Alloy Steel. Consumers will then be free to choose how much of either material—within their total authorised tonnages—they wish to acquire, instead of having amounts specified for each. There will be an exception—tinplate, terneplate and blackplate—which will remain separately allocated as at present. Those who already hold authorisations for Periods in 1953 for Alloy and Non-Alloy materials separately, will shortly receive authority to treat them as applicable to either type of material.

New Stearate Prices

Further reductions in price covering the entire range of its ABRAC Metallic stearates, to take effect immediately were announced by A. Boake, Roberts & Co., Ltd., on 24 October. New prices (per ton) for minimum one-ton lots, without engagement are: aluminium stearate (all grades) £255; calcium stearate, precipitated £233, 'D' £197; lead stearate (30 per cent) £234; lithium stearate SQ £463; magnesium stearate SQ £254; zinc stearate SQ £256. All quotations are net delivered U.K., packing included.

Constitution Amended

A special general meeting of the Society of Cosmetic Chemists of Great Britain was held at St. Ermin's Hotel, London, S.W.1, on 23 October, when the proposed new Constitution and Rules were amended and agreed. The main difference between the old rules and the new rules, which will be operative from 1 November, is that the Society has introduced an associateship in order to cater for those not fully qualified as chemists.

Leeds University Gifts

At the meeting of the Council of the University of Leeds, on 23 October, the following gifts were acknowledged: For the department of inorganic and physical chemistry, £300 from Albright & Wilson, Ltd., Birmingham, for research in analytical chemistry, and £500 for 1952-3 from Monsanto Chemicals, Ltd. For the department of coal, gas and fuel industries, £450 from the British Coke Research Association and £200 from Imperial Chemical Industries, Ltd., for research on diffusion in glass. £250 for research in the department of colour chemistry and dyeing, from Courtaulds, Ltd., and £100 from Shell Chemicals, Ltd., for research in the department of textile industries.

Change of Address

The International Refining Co., Ltd., have announced that as from 15 October their London offices and works have been situated at Roding Lane North, Woodford Bridge, Essex; telephone number: Wanstead 7741.

OVERSEAS

Rohm & Haas Plan Plant

Rohm & Haas Company of Canada, Ltd., plan to build a chemical plant at Scarboro, a suburb of Toronto, on the shores of Lake Ontario. The plant will cover 20 acres and is expected to cost between $3,000,000 and $4,000,000. Rohm and Haas have taken an option on 60 acres in that area.

Uranium Search in Australian Gold Mines

The discovery of uranium in old mining dumps in South Africa has caused Australian mining experts to conduct tests in local mines, to ascertain if Australian gold ores also contain the mineral. So far there has been no indication of uranium in the mines examined. The Victorian Mines Department states that all its own goldfields have been tested, but with discouraging results. Radio-active minerals are widespread, but the quantities are too small to be important. Some of the radioactivity indicated in old dredging areas comes from the presence of monazite or thorium, and not from uranium. As uranium is often associated with copper, copper-gold producing mines in the Northern Territory seem to be more likely sources, and recently miners have requested that the Peko and other mines in the Territory should be tested. This may not take place for some time in view of the known and more important deposits of uranium at Rum Jungle.

Record U.S. Salt Production

The high level of industrial activity in 1951 was reflected in a record production of 20,207,131 short tons of salt according to reports of producers to the U.S. Bureau of Mines. Output was 22 per cent greater than in 1950. Production of salt-in-brine was 27 per cent more than in the previous year, and evaporated salt output gained 10 per cent. Sales of rock salt were 19 per cent higher. The total mine-or-refinery value of the salt produced reached a record level of $69,735,000. Increases were mainly due to enlarged demands of the chemical industries, the largest user being soda ash (41 per cent), and next chlorine and chlorine compounds (23 per cent). Exports of salt, largely to Canada and Japan increased to nearly 440,000 tons.

To Increase Fertiliser Output

Tentative plans drafted by the Japanese Agriculture and Forestry Ministry fix the production of chemical fertilisers at 2,359,190 metric tons in the period 1 August, 1952-31 July, 1953. This is an increase of 122,044 tons over the previous year. Chemical fertiliser exports have been set at 200,000 tons over the next twelve months.

New SO_2 Detector

A new American device for detecting sulphur dioxide in the atmosphere and so preventing a repetition of the 'smog' disaster of 1948 at Donora, Pennsylvania, when 19 people lost their lives, has recently been devised, it is reported. The device consists of a small glass tube filled with a vanadate-silica gel which changes from yellow to green or blue in the presence of sulphur dioxide, which it can detect in concentrations down to 5 p.p.m. Another gel which has also shown promise in tests has a periodate-silica base, turning from white to pink or red-brown. The depth of colour can be used to measure concentration of SO_2.

Kaiser Plant Operating

The Kaiser Aluminium and Chemical Corporation's Chalmette reduction plant near New Orleans is now in full operation with eight potlines. The Chalmette plant, financed at a cost of $150,000,000, will be turning out metal at the rate of more than 1,000,000 lb. per day, and have a capacity of 400,000,000 lb. yearly, or more than the entire U.S. pre-war annual aluminium production. The Chalmette plant is part of Kaiser Aluminium's general expansion programme that is more than doubling its annual primary aluminium capacity to approximately 816,000,000 lb.

Canadian Smelters

Canadian aluminium smelters will shortly be working with bauxite from newly completed facilities in West Africa. The project is owned by Bauxites du Midi, a French subsidiary of Aluminium, Ltd., which has been surveying bauxite potentialities in French West Africa since the early 1920's. At present the Canadian industry obtains most of its bauxite from British Guiana.

· PERSONAL ·

At the annual meeting of the National Union of Manufacturers on 16 October, MR. C. S. GARLAND, A.R.C.S., B.Sc., F.R.I.C., M.I.Chem.E., chairman of Stream-Line Filters, Ltd., resigned the office of honorary treasurer after 27 years' service. He was re-elected a vice-president.

MR. E. J. BOAKE has resigned the chairmanship of A. Boake, Roberts & Co., Ltd., and MR. F. M. ROBERTS the vice-chairmanship. MR. F. G. PENTECOST has been appointed chairman, and he will also continue as managing director, and MR. E. E. BOAKE has been appointed vice-chairman and he will continue to be assistant managing director. Mr. E. J. Boake and Mr. F. M. Roberts will continue to act as directors.

Deputy-chairman of the Supervisory Board of the BP Benzin-und Petroleum Gesellschaft mit beschrankter Haftung, Hamburg, a subsidiary company of the Anglo-Iranian Oil Company, MR. HANS ORNSTEIN celebrated his 40th year of service in the oil industry on 17 October.

Born in Vienna, Mr. Ornstein, at the age of 20, obtained employment with the OLEX Petroleum GmbH, Berlin, as a crude oil specialist and oil salesman. In 1923, when DEA founded the Rheinisch-Westfalische OLEX AG (RWO) in Cologne, he was appointed to the board of directors. Two years later he took over the management of the first sales organisation, which emerged as a result of the amalgamation of the RWO and the OLEX Petroleum Sales Company, and early in 1933 he was appointed to the managerial board of the OLEX head office in Berlin, this company in the meantime having been taken over by the AIOC. In May he went to Paris and later became a French citizen. After the war the AIOC appointed him manager of the German enterprise.

Following the retirement of LIEUT.-COL. L. J. BARLEY, the duties of I.C.I.'s Overseas Development and Home Development Controllers have been combined under MR. L. S. MUMFORD, who will, in future, be known as the development controller.

Aged 46, Mr. Mumford joined I.C.I. in 1929 from University College, London, where he had been engaged on research, and was posted to I.C.I. Billingham (then Synthetic Ammonia & Nitrates, Ltd.). He left Billingham in 1942 after varied experience and was transferred to I.C.I. head office development department. He was appointed home development controller in 1944.

Obituary

The death occurred on 24 October of MR. NOEL GARROD THOMAS, C.B.E., M.A., M.Sc., who for 37 years was associated with the sulphuric acid industry and played an important part fostering good relations with the suppliers of raw materials from overseas. Mr. Garrod Thomas, who was 67, retired last June from the post of general manager of the National Sulphuric Acid Association, Ltd., a post which he had held since the formation of the association in 1919. During the last war he was appointed Controller of Sulphuric Acid by the Minister of Supply. He was educated at Rugby School, Balliol College, Oxford, and Harvard University.

MR. FRED H. HAGGERSON, chairman of the board of Union Carbide & Carbon Corporation, died in New York City, on 14 October, after a short illness. He was 68 years old. Mr. Haggerson, who had been with Union Carbide for over 33 years, became chairman of the board in 1951.

Next Week's Events

MONDAY 3 NOVEMBER

Society of Chemical Industry

London: Burlington House, Piccadilly, W.1, 6.30 p.m. Alan St. H. Brock: 'The Art and Craft of Firework Making.'

Institution of Works Managers

Halifax: 7.30 p.m. R. Shilton: 'Problems of Production Planning.'

TUESDAY 4 NOVEMBER

Hull Chemical & Engineering Society

Hull: Church Institute, Albion Street, 7.30 p.m. Colonel B. Ungerson: 'Personnel Selection.'

Incorporated Plant Engineers

Cardiff: South Wales Institute of Engineers, Park Place, 7.15 p.m. 'Chrome and Nickel Plating Processes.'

Institute of Metal Finishing

Birmingham: James Watt Institute, Great Charles Street. One-day autumn meeting. Afternoon 2.30-5.15 p.m. Evening 6.30 p.m. Papers and discussion on: 'Low Costs—High Productivity in Electroplating.'

WEDNESDAY 5 NOVEMBER

The Chemical Society

Dublin: University College, Upper Merrion Street, 7.45 p.m. Professor A. R. Ubbelohde: 'Recent Physico-chemical Studies on π Electrons in Solids.'

Reinforced Concrete Association

Liverpool: Liverpool Engineering Society, Dale Street, 6.30 p.m. Chairman's evening.

Society of Public Analysts

London: Burlington House, Piccadilly, W.1., 7 p.m. Meeting on 'The Bioassay of Vitamins,' organised by the Biological Methods Group. Dr. L. J. Harris: 'Introductory Survey'; Dr. E. C. Wood: 'Efficient Planning of Microbiological Assays, Particularly Assays of Vitamin B_{12}'; and H. Pritchard: 'Selection of Methods for Routine Assays for Members of the Vitamin B Complex.'

British Ceramic Society

London: 90 Buckingham Palace Road, S.W.1. Autumn meeting of the Refractory Materials Section. 9.30 Council and general business meeting; 10.15 a.m.-12.30 p.m. and 2 p.m. technical sessions; papers on 'Hot Pressing of Refractory Oxides,' 'The Corrosion of Refractories by Slags,' and 'The Chemical and Physical Properties of Silica Bricks'; 6.15 p.m. dinner and concert, Royal Festival Hall.

Incorporated Plant Engineers

Southampton: Polygon Hotel, 7.30 p.m. J. C. Chynoweth: 'Steam Utilisation.'

THURSDAY 6 NOVEMBER

Royal Institute of Chemistry

London: West Ham Municipal College, Romford Road, E.15, 7 p.m. Dr. C. C. Hall: 'The Fischer-Tropsch Synthesis.'

The Chemical Society

London: Burlington House, Piccadilly, W.1, 7.30 p.m. Wilstätter Memorial Lecture by Sir Robert Robinson, O.M.

Liverpool: University, 5 p.m. Joint meeting with the RIC, SCI and BAC. Professor G. R. Clemo: 'Some Aspects of the Chemistry of Sesquiterpenes.'

Society of Chemical Industry

Aberdeen: Marischal College, 5.30 p.m. Joint meeting of the North of Scotland Section with the Chemical Society and the RIC. Miss M. Olliver: 'A Survey of Pectin, Past and Present.'

Nottingham: Nottingham and District Technical College, 7.15 p.m. J. G. Window: 'Industrial Uses of Glass Plant.'

Society of Leather Trades' Chemists

Northampton: College of Technology, 2.30 p.m. M. Hirsch: 'The Drying of Leather.'

Society of Public Analysts

Glasgow: Royal Technical College, 7.15 p.m.; meeting on 'Quantitative Microscopy in Relation to Plant Tissue.'

British Ceramic Society

London: 90 Buckingham Palace Road, S.W.1. Autumn meeting of the Refractory Materials Section. 10 a.m. Final technical session.

Incorporated Plant Engineers

Peterborough: Eastern Gas Board's demonstration theatre, Church Street, 7.30 p.m. L. Evans (district representative, Shell Mex and B.P.): 'Anti-corrosives,' Film: 'Red Ruin,' and others.

The Royal Society

London: Burlington House, Piccadilly, W.1, 4.30 p.m. A. S. Parkes and Audrey U. Smith: 'Regeneration of Rat Ovarian Tissue Grafted after Exposure to Low Temperatures.'

FRIDAY 7 NOVEMBER

Society of Chemical Industry

Manchester: University, 6.30 p.m. Levinstein Memorial Lecture. Professor H. J. Emeléus: 'Some Recent Advances in Fluorine Chemistry.'

The Royal Institution

London: 21 Albemarle Street, London, W.1, 9 p.m. Dr. D. P. Riley (Senior Research Fellow, Davy Faraday Research Laboratory): 'The Chemistry of an Egg.'

Institution of Chemical Engineers

Middlesbrough: 6.15 p.m. North East Centre, Graduates' and Students' Section (Details from Centre hon. secretary). Professor Shelby-Miller: 'Agitation.'

Institute of Industrial Management

Manchester: College of Technology, 6.15 p.m. Visit of the Anglo-American Productivity Team on 'Education for Management.' Leader: Sir Hugh Chance (chairman, Chance Brothers, Ltd., Glassworks, Smethwick).

National Chemical Products, Ltd.

Reporting on the satisfactory results achieved in 1951, Mr. J. L. Irvin, chairman of National Chemical Products, Ltd., South Africa, also announced the proposal to increase its capital by £300,000 to £1,000,000. An offer will be made of 250,000 ordinary and 50,000 £1 preference shares, one new preference share for every one held, and one new ordinary share at 30s. for every two held. Another 30,000 ordinary shares at 30s. will go to the Distillers Co., Ltd., of Edinburgh, and 17,275 ordinary shares at 30s. are to be issued at discretion.

CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 *inclusive, or a woman aged* 18-59 *inclusive, unless he or she, or the employment, is excepted from the provisions of the Notifications of Vacancies Order,* 1952.

BAYER PRODUCTS, LTD., require a **TECHNICAL REPRESENTATIVE** to develop commercially certain Pharmaceutical Chemicals that have uses in other industries. Selling ability and a background of Chemistry or Pharmacy are essential. The successful candidate will spend most of his time in the field and will be given every opportunity to use his initiative to develop new business. The position has good prospects for the man who can bring energy to a creative job. A car will be provided. Applications to **SALES DIRECTOR, BAYER PRODUCTS, LTD., AFRICA HOUSE, KINGSWAY, LONDON, W.C.2.**

MINISTRY OF SUPPLY requires **PHYSICAL CHEMIST** (male) for post as Scientific Officer or Senior Scientific Officer at Research Establishment in S.W. England, to lead a small group working upon a variety of research problems in Physical Chemistry. Candidates must have 1st or 2nd Class Honours Degree, or equivalent, in Chemistry. Research experience in Infra-red, Thermo-Chemistry or Reaction Kinetics is desirable and an interest in modern analytical techniques an advantage. Salary within range : Senior Scientific Officer (minimum age 26 years and at least three years' post-graduate experience), £781-£980 ; Scientific Officer, £417-£675. F.S.S.U. unestablished. Forms from **M.L. & N.S. TECHNICAL AND SCIENTIFIC REGISTER (K), ALMACK HOUSE, 26, KING STREET, S.W.1.,** quoting F.669/52A. Closing date, 22nd November, 1952.

NORTH THAMES GAS BOARD. A **CHEMIST** or **PHYSICIST** is required in the Laboratories at **WATSON HOUSE, FULHAM, S.W.6,** to undertake research work on coke utilisation and the design of solid fuel-fired appliances. Previous experience in this field would be an advantage but is not essential. Candidates should be not less than 25 years of age and hold an Honours Degree.

The appointment is of a permanent nature and pension arrangements will be discussed with short-list candidates. Starting salary will be within the range £550 to £700 per annum, according to age, qualifications and experience.

Applications should be sent to the **STAFF CONTROLLER, NORTH THAMES GAS BOARD, 30, KENSINGTON CHURCH STREET, W.8,** quoting **REFERENCE 666/50,** to reach him within ten days of the appearance of this advertisement.

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CENTRAL MANCHESTER OFFICES
with Secretarial, Duplicating Services available with outside representation if necessary, seeking firms requiring Manchester or North-West Administrative Office or Northern Headquarters.

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MORTON, SON & WARD, LIMITED,
offer
JACKETED BOILING PANS

NEW and available for immediate delivery: 100 gallon, welded construction, mounted on three legs and certified for 100 lb. p.s.i. w.p.
150 and 200 gallon, all welded, mounted on three legs and certified for 80 lb. p.s.i. w.p.

SECOND-HAND :
ONE 600 gallon totally enclosed **JACKETED AUTOCLAVE** with detachable top cover, of riveted construction, suitable for 180 lb. p.s.i. w.p. in jacket and 100 lb. w.p. internally.
ANY OF THE ABOVE CAN BE ARRANGED WITH MIXING GEAR, MOTORISED OR FAST AND LOOSE PULLEY.

MIXERS
"MORWARD" **"U"**-shaped Trough **POWDER MIXERS** in sizes 8 to 100 cu. ft., arranged with scroll-type mixing gear.
ONE 3 cwt. capacity **GARDNER TROUGH MIXER,** stainless steel lined trough and twin chrome-plated scroll blades mounted on stainless steel shaft. Fast and loose pulley drive.
Horizontal Churn-type **MIXING VESSELS** and Vertical **MIXING VESSELS,** totally enclosed and open top in various sizes.
ALL TYPES OF MIXING VESSELS CONSTRUCTED TO REQUIREMENTS.
ONE CHRISTY AND NORRIS DISINTEGRATOR, size 00, arranged with worm and funnel feed.
ONE 600 gallon **STAINLESS STEEL TANK,** 6 ft. by 3 ft. by 6 ft. deep, 16's gauge, mounted in channel iron frame.
ONE Stainless Steel **AGITATOR,** direct coupled to 5 h.p. geared motor.
SEVERAL Flange-mounted **GEARED MOTORS** suitable for agitator drives.
NUMEROUS All-Bronze, Brass Tube **CONDENSERS** or **HEAT EXCHANGERS** by Serck in stock.
A LARGE SELECTION of **HYDRO EXTRACTORS,** all electric, under driven, 72 in., 60 in., 48 in. and 42 in., by **BROADBENT** and **WATSON LAIDLAW,** in stock.

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DRAGON FLAME GUNS make an adaptable Portable Forge and are used extensively in boilers in conjunction with solid fuel to raise steam quickly. Excellent for heating metal, removing rust, etc. Two gallons paraffin gives two hours' burning. 2,000 deg. flame temperature. No instruction necessary. Perfectly safe. Full descriptive literature from **MORTON LONGLEY, LIMITED, 200, THE BEACON, HILLINGDON, MIDDX.**

GRAVITY Roller Conveyor several lengths, Rolls. 2¼ in. diam. by 16 in. 3 in. centres. Good condition. **THOMPSON & SON (MILLWALL), LIMITED, CUBA STREET MILLWALL E.14.** (Tel. : East 1844.)

SCREENLESS PULVERIZERS for fine grinding of Chemicals. Also **CYCLONES, ROTARY VALVE FEEDERS. Callow (Engrs.) Ltd. Kirkby Trading Est., Liverpool.**

FOR SALE

VARIOUS MIXERS FOR SALE

ONE 1½ size Harrison Carter **DISINTEGRATOR.** Enclosed **STORAGE TANK,** 5 ft. 8 in. by 11 ft. 8 in. by 10 ft., deep, in Buckingham.

Two Miracle No. 1 size **HAMMER MILLS,** belt driven, with fans and cyclones.

Three Perplex-type **IMPACT GRINDERS,** 24 in. and 30 in. circular grinding chambers.

Two Turner 2½-sheet No. 2 **DRESSING MACHINES,** ball bearing.

Size No. 3 Junior Hammamac **HAMMER MILL** with fan and cyclone, also No. 1 size Miracle **GRINDING MILLS.**

Robinson 3-sheet No. 1 size **CENTRIFUGAL DRESSING MACHINE** for dry powders, etc.

Two **ROTARY BOWL MIXERS.** 5 ft. diam., cast-iron built, inclined agitators by Baker Perkins

One excellent **EVAPORATING UNIT,** comprising Copper Vessel, 4 ft. diam. by 5 ft. 6 in. deep, jacketed on the bottom, with copper swan-neck, C.I. catch-pot, vacuum pump and fittings including thermometer and gauge.

Large unjacketed **WERNER MIXER,** belt and gear driven, hand tipping, double " Z " arms, pans 31 in. by 45 in. by 36 in. deep.

No. 200 One nearly new **WERNER PFLEIDERER JACKETED MIXER OR INCORPORATOR.** Low type, with C.I. built mixing chamber, 28 in. by 29 in. by 27 in. deep, with double " U "-shaped bottom which is jacketed, and double fish-tail or fin-type agitators geared together at one side, with belt-driven friction pulleys, 34 in. diam. by 5 in. face, with hand-wheel operation and hand-operated screw tilting gear. Machine fitted with machine-cut gears, covers, gear guard, cast-iron baseplate, and measuring overall approximately 7 ft. by 6ft. by 4 ft. high to the top of the tipping screw

No. 209 One **HORIZONTAL " U "-SHAPED MIXER,** steel built, riveted, measuring about 8 ft. 3 in. long by 3 ft. wide by 3 ft. 3 in. deep, with horizontal shaft, fitted with bolted-on mixing arms about 18 in. long by 4 in. wide, with intermediate breakers, and driven at one end by a pair of spur gears, with countershaft, fast and loose belt pulleys, outer bearing and plug cock type outlet at the opposite end, mounted on two cradles fitted to two R.S.J. running from end to end.

One **FILTER PRESS,** fitted 68 wood recessed plates, 2 ft. 8 in. square, centre fed, with enclosed bottom corner delivery, cloth clips and belongings.

One **DEHNE FILTER PRESS,** cast-iron built, fitted 45 recessed ribbed plates, 2 ft. 8 in. by 2 ft. 8 in. by 1¼ in., with bottom corner feed, cloth clips and bottom corner separate outlets, angle lever closing gear, etc.

SIMON HORIZONTAL TUBULAR STEAM-HEATED DRIER, barrel with steam-heated tubes, 12 ft. long by 5 ft. diameter.

Further details and prices upon application.

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CHEMICAL PLANT

LABOUR **CENTRIFUGAL PUMP,** size O, No. 50 MW. Capacity, 65 gals. per min. Sulphuric acid, 80/85 per cent strength. All contact parts fabricated in lead (regulus metal). Motorised, 400/3/50.

Selas Type 9 **GAS AND AIR MIXING MACHINE,** comprising gas inlet governor, air and gas proportioning valve with vernier adjustment, back pressure valve, booster unit, and delivery pressure controller. Maximum capacity, 25,000 cu. ft. per hour. Air/gas mixture at adjustable delivery pressure.

De-airing type **PUG MILL** by Bonnot. Primary chamber, 4 in. diam.; secondary worm extruder, 3 in. diam.; 3 in. discharge with 7½ in. by 9 in. opening. Of aluminium construction with stainless steel shaft and worms. Motorised, 220/440/3/50.

SIFTER MIXER by Young, with trough, 70 in. by 26 in. by 26 in. deep. Blending chamber feeds material to positive action brush sifter in trough screen. Broken scroll agitator. Pulley drive.

Horizontal **MIXER,** single trough, 4 ft. by 1 ft. 9 in. by 2 ft. 4 in. deep. " Z "-type agitator. Pulley drive. Arranged hand tilting.

Baker Perkins **TROUGH TILTING MIXER.** Alloy trough, 20 in. by 14 in. by 17 in. deep, with cover. Gunmetal gate-type agitators. Fast and loose pulley drive.

48 in. diam. Underdriven **HYDRO EXTRACTOR** by Thomas Broadbent, with mild steel galvanised basket 48 in. diam. by 25½ in. deep, with ¼ in. perforations at 1½ in. pitch. Open-type machine, 3-point suspension. Motorised, 400/3/50.

Cast-iron Plate and Frame **FILTER PRESS,** 32 plates for cakes 36 in. sq., 1⅛ in. thick. 3-in. flanged bottom outlet. Hand-operated closing.

Two Unused Johnson Wooden Plate and Frame **FILTER PRESS CARCASSES.** Hydraulic closing gear. Frame size, 61 in. by 49 in. Cake size, 48 in. by 38 in. by 2⅜ in. Suitable for 28 chambers. Rubber-lined filtrate trough.

New 50-gal. Stainless Steel Tilting-type **BOILING PANS** in F.D.P. material. 80 p.s.i. w.p.

New ½ h.p. 400/3/50 **SLOW-SPEED STIRRERS.** Stainless steel shaft 5 ft. long, at 420 r.p.m.

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